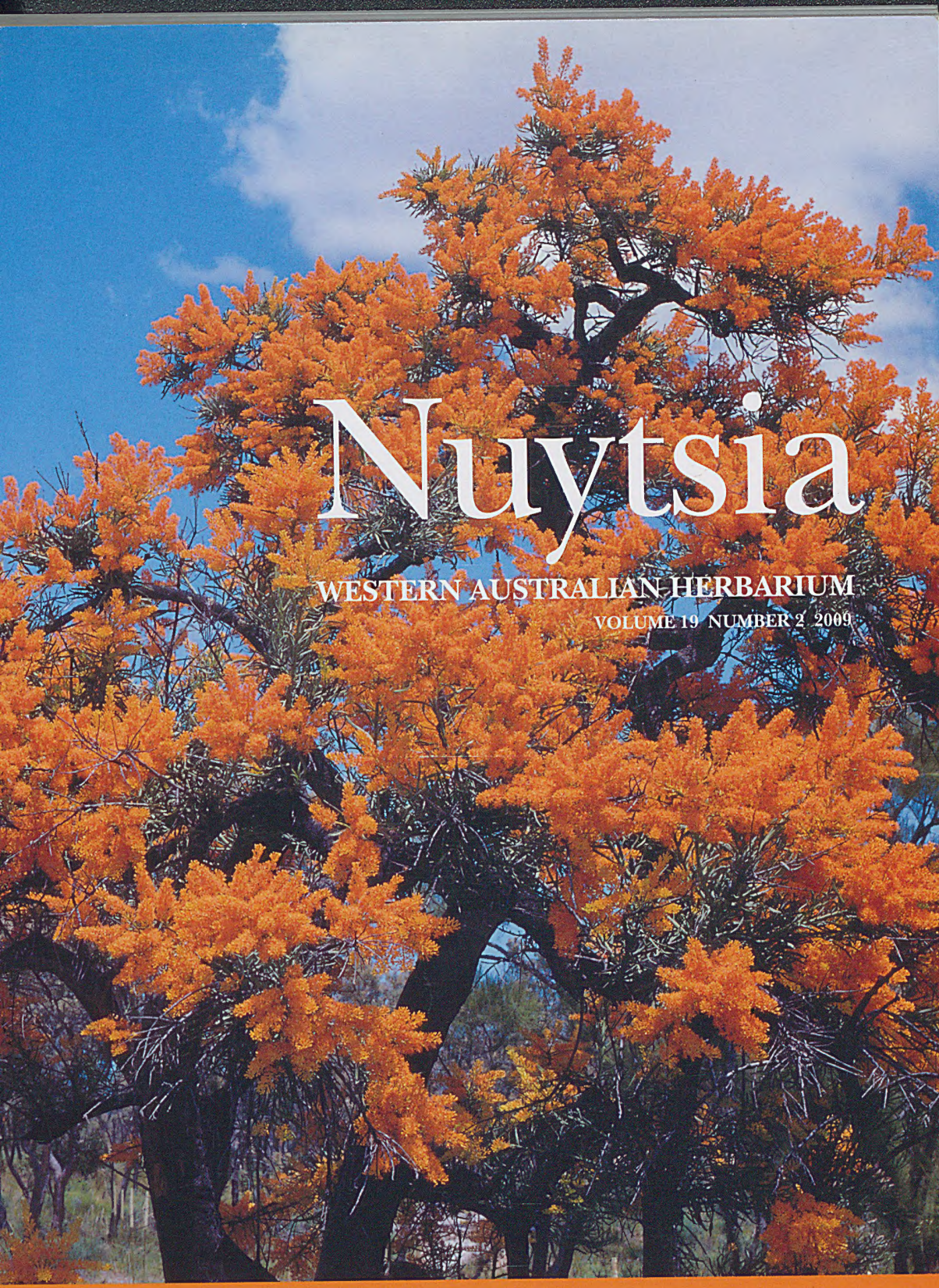

Nuytsia

WESTERN AUSTRALIAN HERBARIUM

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Environment and Conservation

Cover

Nuytsia floribunda (Labill.) R. Br. ex Fenzl (Loranthaceae) – the Western Australian Christmas Tree is one of the few arborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the 'Gulde Zeepaard' on one of the first explorations along the south coast of Australia.

Photograph: A.S. George

Nuytsia

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CONTENTS

CONTENTS (*continued*)

Other contents

Lectotypification of ten Restionaceae species names from south-west Western Australia

Russell L. Barrett[1,2,3] and Barbara G. Briggs[4]

[1]Botanic Gardens & Parks Authority, Fraser Ave, West Perth, Western Australia 6005
[2]School of Plant Biology, The University of Western Australia, 35 Stirling Highway, Crawley, Western Australia 6009
[3]Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
[4]National Herbarium of New South Wales, Royal Botanic Gardens,
Mrs Macquaries Rd, Sydney, New South Wales 2000
Email: russell.barrett@bgpa.wa.gov.au

Abstract

Barrett, R.L. & Briggs, B.G. Lectotypification of ten Restionaceae species names from south-west Western Australia. *Nuytsia* 19(2): 203–209 (2009). A lectotype is selected for ten names published in 1993 and 1996 by K.W. Dixon, K.A. Meney and J. Pate for species of Restionaceae in the genera *Desmocladus* Nees, *Harperia* W.Fitzg., *Hypolaena* R.Br., *Lepidobolus* Nees, *Loxocarya* R.Br., *Onychosepalum* Steud., *Leptocarpus* R.Br. and *Restio* Rottb. The relevant species originally named in *Leptocarpus* and *Restio* are now included in *Meeboldina* Suess. and *Chordifex* B.G.Briggs & L.A.S.Johnson respectively. Additional collections of the ten taxa involved are also cited.

Introduction

Lectotypification of the names of one Restionaceae species published by Dixon and Meney (Dixon *et al.* 1993) and nine Restionaceae species published by Meney *et al.* (1996) is necessary as all of the type specimens cited in these two papers appear to have been lost. A lectotype is selected for the following eight names, for which no holotype or isotype can be found: *Harperia ferruginipes* Meney & Pate, *Hypolaena robusta* Meney & Pate, *Desmocladus glomeratus* K.W.Dixon & Meney, *Lepidobolus basiflorus* Pate & Meney, *Lepidobolus spiralis* Meney & K.W.Dixon, *Leptocarpus crassipes* Pate & Meney, *Loxocarya albipes* Pate & Meney and *Onychosepalum microcarpum* Meney & Pate. An illustration is designated as the lectotype for *Loxocarya magna* Meney & K.W.Dixon and for *Restio isomorphus* K.W.Dixon & Meney. Since their original description, *Restio isomorphus* has been transferred to *Chordifex* B.G.Briggs & L.A.S.Johnson and *Leptocarpus crassipes* to *Meeboldina* Suess. (Briggs & Johnson 1998).

In the protologue of each of these names only the holotype and isotype(s) were cited, although it is evident that other collections were made by the authors. In each case an illustration by E. Hickman, showing features of both male and female plants, was included in the protologue. These illustrations were subsequently also published in the excellent book *Australian rushes: biology, identification and conservation of Restionaceae and allied families* (Meney & Pate 1999).

The original citations indicate that type specimens are housed at K, KPBG, PERTH and SYD. The reference to SYD was intended to be to the National Herbarium of New South Wales (NSW) rather than the University of Sydney Herbarium (SYD). One author of the relevant papers (K. Dixon pers. comm.) confirms that despite comprehensive searching, the cited types for most of the species have not been located at PERTH, KPBG or UWA. Likewise, isotypes cited as housed in K and SYD [NSW], cannot be found.

For those names for which both the holotype and the cited isotype(s) are no longer extant, and no other specimens were cited in the protologue, the lectotype must be chosen (McNeill *et al.* 2006: Art. 9.10) from 'among the uncited specimens and cited and uncited illustrations which comprise the remaining original material, if such exist'. Specimens that we consider to be original material have been located at KPBG (the place of work of K. Meney and K. Dixon), UWA (at J. Pate's former Department) and NSW. The specimens at NSW were sent by these authors to B.G. Briggs and L.A.S. Johnson, who were then also studying Restionaceae. The curators of the KPBG and UWA herbaria have agreed to the transfer to PERTH of those specimens from their collections and they are here designated as lectotypes. Lectotypes at NSW were sufficiently ample to divide so that an isolectotype could be placed in PERTH. The locations of the lectotypes are indicated below.

The *International Code of Botanical Nomenclature* (*Vienna Code*) (ICBN, McNeill *et al.* 2006) states (Article 9.2, Note 2) that the original material includes 'those specimens and illustrations (both unpublished and published either prior to or together with the protologue) upon which it can be shown that the description or diagnosis validating the name was based'. The original material also includes 'isotypes or isosyntypes of the name irrespective of whether such specimens were seen either by the author of the validating description or diagnosis, or the author of the name' (Art. 9.2 Note 2[c]). Uncited specimens may also be original material (Art. 9.10).

Ross (2002) argued that an illustration that forms part of the protologue is not original material unless it was used in the preparation of the validating description and we agree that the wording of Note 2 of Article 9.2 of the ICBN could be interpreted that way. We are, however, here following common practice, as endorsed by the acceptance of a proposal by Silva (1993), and reference in Note 2 of Article 9.2 to illustrations published with the protologue. Thus we have accepted that any illustration cited in the protologue of a name is original material of that name. Although not affecting the names lectotypified here, we note that the designation of an illustration as the type of a name was limited in the current ICBN to names published prior to 1 January 2007 (unless the provisions of Article 37.5 – mainly concerning microscopic organisms – apply). Although the Code permits an illustration to be designated as the lectotype of a name published prior to 1 January 2007, provided that no cited specimens are extant, we consider that specimens should be given priority over illustrations and so we have only designated an illustration as the lectotype of a name if we could not locate any uncited specimens.

In the two cases where an illustration is designated as the lectotype, we have also specified a reference specimen housed at NSW, with a duplicate at PERTH, that is closely linked with the original type gathering, locality and collectors. These representative specimens have no formal status and are not being designated as epitypes. Should one of these illustrations prove to be ambiguous for application of a name at any point in the future, it is recommended that the representative specimen chosen here then be selected as an epitype. These representative specimens are believed to be from the localities where the holotypes were collected, although there are differences in the way the locations are cited.

Lectotypifications that designate original specimens

Desmocladus glomeratus K.W. Dixon & Meney, *Telopea* 6: 649–651, fig. 1 (1996). *Type citation*: 'Northampton (28° 21' S, 114° 38' E), *Meney & Dixon KM 909* (female plant), 10 August 1990 (holotype KPBG; isotype PERTH)' [both lost]. *Type specimen*: north of Geraldton, Western Australia [precise locality withheld for conservation reasons], 10 August 1990, *K. Meney & K. Dixon* [as KM/KD] *s.n.*, ♂ (*lecto,* here designated: NSW 779666; *isolecto*: PERTH 07953402).

The lectotype was labelled as 'Loxocarya "glomerata" (Dixon & Meney)' in K.A. Meney's hand and sent by her to Briggs and Johnson at NSW as an example of their new-found species (species of *Desmocladus* were mostly referred to *Loxocarya* at that time). It is thought to be from the gathering upon which the features of male plants, mentioned in the protologue, were based. Despite the difference in locality citation, we believe that the lectotype is from the type location, collected by the relevant authors on the same day as the female specimen originally designated as the type. The protologue states 'The species is known from only one location in sand over laterite in heathland' and cites a specific locality from north-east of Geraldton, which matches the locality of the lectotype rather than the vague locality of 'Northampton' used in the type citation. *Desmocladus glomeratus* is now known to be more widespread.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 25 Aug. 2006, *B.G. Briggs* 9684 ♂ (NSW, MEL, RSA), 9685 ♂ (NSW, PRE), 9686 ♀ (NSW, CANB, MEL); 14 Aug. 1991, *B.G. Briggs* 8887a *& L.A.S. Johnson* ♂ (NSW 246565, PERTH, MO), 8887b ♀, (NSW); 2 Oct. 1976, *D. & N. McFarland* NM 1276 (PERTH); 1992, *J. Pate s.n.* ♂, ♀ (NSW); 22 Sep. 1976, *T. Whaite* 4163 *& J. Whaite* ♂ (NSW, CANB, K, PERTH).

Harperia ferruginipes Meney & Pate, *Telopea* 6: 651–653, fig. 2 (1996). *Type citation*: 'between Geraldton (28° 46' S, 114° 37' E) and Mullewa (28° 32' S, 115° 30' E), *Meney & Pate KM 9401*, 19 April 1994 (holotype KPBG; isotype PERTH)' [both lost]. *Type specimen*: 'Known only from 3 closely located populations between Geraldton & Mullewa', Western Australia, April 1994, *J.S. Pate s.n.*, ♂ (*lecto,* here designated: PERTH 08027900 (ex UWA)).

This specimen, collected by one of the authors of the name, was held at UWA (the former department of J. Pate) until transferred to PERTH recently and so it is reasonable to assume that it would have been used in the preparation of the description. It was probably collected from the type locality.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons], 5 Oct. 1995, *B.G. Briggs* 9358 [*& J.S. Pate*] ♂ (NSW, PERTH, MO), 9359 ♂ (NSW, PERTH); 7 Apr. 1992, *K.F. Kenneally* 11140 (PERTH); May 1994, *J. Pate s.n.* ♂ (NSW); 29 Aug. 2003, *Wildflower Society of WA* EURA 131 (PERTH); 3 Oct. 2003, *Wildflower Society of WA* EURA 132 (PERTH).

Hypolaena robusta Meney & Pate, *Telopea* 6: 653, fig. 3 (1996). *Type citation*: 'near Badgingarra (30° 24'S, 115° 33' E), *Meney & Pate KM 9092*, 6 September 1990 (holotype KPBG; isotype PERTH)' [both lost]. *Type specimen:* 'Badgingarra (only known location)', Western Australia, September 1990, *J.S. Pate s.n.* ♀ (+ ♂ fragment) (*lecto*, here designated: PERTH 08027897 (ex UWA)).

This specimen, collected by one of the authors of the name, was held at UWA (the former department of J. Pate) until transferred to PERTH recently and so would have been available to the authors when they were preparing the description.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 8 Sep. 1990, *B.G. Briggs* 8630, *L.A.S. Johnson, K. Meney, J. Pate & P. Linder* ♂ (NSW); 6 Oct. 1995, *B.G. Briggs* 9381 & *J. Pate* ♂ (NSW, PERTH), 9382 ♀ (NSW, PERTH); 24 Aug. 2003, *B.G. Briggs* 9557a ♂ (NSW, PERTH, PRE); 30 July 1995, *M. Hislop* 56 (PERTH); 22 Sep. 2002, *F. & J. Hort* 1811 (PERTH); 21 October 2006, *F. & B. Hort* 2940 (PERTH); 1 Sep. 1999, *M.E. Trudgen* 20121 & *S. Firth* (PERTH, NSW); 2 Oct. 1979, *K.L. Wilson* 2685 ♂ (NSW).

Lepidobolus basiflorus Pate & Meney, *Telopea* 6: 655–656, fig. 4 (1996). *Type citation*: 'between Geraldton (28° 46' S, 114° 37' E) and Mullewa (28° 32' S, 115° 30' E), *Pate & Meney KM9402*, 19 April 1994, (holotype KPBG; isotype PERTH)' [both lost]. *Type specimen*: south-west of Tenindewa, Western Australia [precise locality withheld for conservation reasons], May 1994, *J. Pate s.n.*, ♂ (*lecto,* here designated: NSW 363208, *isolecto*: PERTH 07953151).

This specimen was sent to NSW in 1994 with advice of its proposed name given in correspondence to B.G. Briggs and so is considered to be part of the gatherings studied by the authors prior to publication of the name *Lepidobolus basiflorus*. The protologue states that *L. basiflorus* was then only known from one population, so the lectotype is presumably from the type locality.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 5 Oct. 1995, *B.G. Briggs* 9362 & *J. Pate* ♂ (NSW, PERTH, NBG), 9363 ♀ (NSW); May 1994, *J. Pate s.n.* ♀ (NSW).

Lepidobolus spiralis Meney & K.W. Dixon, *Telopea* 6: 656–658, fig. 5 (1996). *Type citation*: 'Frank Hann National Park, east of Lake King (33° 05' S, 119° 40' E), *Meney & Dixon KM293*, 2 November 1990, (holotype KPBG; isotype PERTH)' [both lost]. *Type specimen*: Lake King–Norseman road, Western Australia [precise locality withheld for conservation reasons], 2 November 1990 [labelled as 4 March 1993], *K. Meney* 293 ♀ (*lecto,* here designated: NSW 267532; *isolecto*: PERTH 07953410).

The localities of the holotype and lectotype are different descriptions of the same general location; the same collection number is given, although the collections were labelled with different dates. K. Meney has confirmed that there is actually only a single gathering involved, collected on 2 November 1990, the duplicate having been sent to B. Briggs on 4 March 1993, hence the date on the lectotype sheet. It was labelled in Meney's hand 'Lepidobolus contortus K. Meney & K. Dixon', an earlier manuscript name for the species; this was not used when the species was named but referred to the same feature of its growth.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 4 Oct. 1995, *B.G. Briggs* 9349, *J. Pate & K. Meney* (NSW, PERTH, CANB, AD); cultivated, 2 Nov. 1990, *K. Meney* 3291 (NSW); 2 Sep. 1988, *K. Meney & K. Dixon* 814 (KPBG); 2 Nov. 1990, *K. Meney & K. Dixon s.n.* (KPBG); 13 Nov. 1979, *K.R. Newbey* 6575 (PERTH).

Loxocarya albipes Pate & Meney, *Telopea* 6: 660–662, fig. 7 (1996). *Type citation*: 'Wongan Hills (30° 51' S, 116° 43' E). In a single small gravel pit 15 km W of Wongan Hills. *Pate & Meney KM 9304*, 10 August 1993 (holotype KPBG; isotype PERTH)' [both lost]. *Type specimen*: gravel pit, east of Wongan Hills on the Piawaning Road, Western Australia [precise locality withheld for conservation reasons], October 1993, *J. Pate s.n.* ♀ (*lecto,* here designated: NSW 280360, *isolecto*: PERTH 08027609).

A small tag on the lectotype is annotated in Pate's hand 'Adult plants from just outside the gravel pit. Better young fruits than earlier material.' Also, the notes included on the NSW label 'Rhizomes on ground surface, as the coarse gravel will not allow burial. Rhizomes wooly. Female.' come from Pate's field observations. The protologue records the species as known only from a lateritic gravel pit. The protologue and some of the following collections cite an incorrect location; K. Dixon confirms that the lectotype is from the type location. It was sent to NSW after Pate and Meney had studied the new taxon sufficiently to specify its distinctive features, but before the relevant name was published.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 5 Oct. 1995, *B.G. Briggs* 9353 *& J. Pate* ♂ (NSW, PERTH), 9354 ♀ (NSW, PERTH), 9355 ♀ (NSW); 23 Sep. 1999, *M.J. Fitzgerald* MJF 99/001 (PERTH); Oct. 1993, *J. Pate s.n.* ♂ (NSW); Apr. 1994, *J.S.Pate s.n.* ♂, ♀ (UWA).

Meeboldina crassipes (Pate & Meney) B.G.Briggs & L.A.S.Johnson, *Telopea* 8: 30 (1998). – *Leptocarpus crassipes* Pate & Meney, *Telopea* 6: 658–660, fig. 6 (1996). *Type citation*: 'Kent River between Denmark (34° 58' S, 117° 21' E) and Walpole (34° 59' S, 116° 44' E), *Pate & Meney KM913*, 5 January 1991 (holotype KPBG; isotype PERTH)' [both lost]. *Type specimen*: Kent River, Western Australia, 5 January 1991 [but labelled as 1992], *K. Meney* 913 ♂, ♀ (*lecto*, here designated: NSW 409875; *isolecto*: PERTH 07953178); Kent River, Western Australia [precise locality withheld for conservation reasons], 5 January 1991, [*J. Pate* &] *K. Meney s.n.* ♂, ♀ (*isolecto*: PERTH 08027919 (ex KPBG).

Based on label information there appear to be two collections, however, correspondence with K. Meney has confirmed that there is actually only a single collection involved, made on 5 January 1991. A duplicate of this collection was sent to B. Briggs at NSW in 1992, hence the date on the sheet with K.A. Meney's collection number of 913 at NSW, now with a portion at PERTH. The sheet at PERTH ex KPBG does not bear the Meney collection number and does not list Pate as the co-collector, and is thus excluded from being the holotype, however the label represents a deficiency of the hand-written notes on the sheet, and again, K. Meney confirms that it is part of the original (and single) gathering made of this taxon on this day by Pate and Meney, so it must also be considered an isolectotype.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons],10 Nov. 2004, *R.J. Cranfield & B.G. Ward* WFM 233 (PERTH); 18 Mar. 1961, *A.S. George* 2323 (PERTH); 3 May 1991, *N. Gibson & M. Lyons* 633–636 (PERTH); 19 Jan. 1992, *N. Gibson & M. Lyons* 804 (PERTH); no date, *J.S. Pate s.n.* ♂ (UWA).

Onychosepalum microcarpum Meney & Pate, *Telopea* 6: 664, fig. 9 (1996). *Type citation*: 'Gingin (31° 21' S, 115° 54' E) to Cataby (30° 45' S, 115° 33' E) *Meney & Pate KM 9091*, 6 September 90 (holotype KPBG; isotype PERTH).' [Both lost]. *Type specimen*: west of Brand Highway, Western Australia [precise locality withheld for conservation reasons], September 1990, *K. Meney s.n.* ♂ (*lecto*, here designated: PERTH 08027935 (ex KPBG); *isolecto*: PERTH 08027927 (ex KPBG)).

There are three sheets of specimens that appear to be original material, one housed until recently at UWA and the other two at KPBG. All would have been available to the authors when preparing their description of the species. The locations are differently described but both are consistent with the type locality. The sheets selected as lectotype and isolectotype are a gathering of male plants with more accurate locality information than the *Pate s.n.* collection from Cataby listed below.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 6 Sep. 1990, *B.G. Briggs* 8583, *L.A.S. Johnson, K. Meney, J. Pate & P. Linder*, ♀ (NSW, PERTH, BOL, MEL, K), 8582 ♂ (NSW); 6 Oct. 1981, *E.A. Griffin* 3177 (PERTH, NSW); 7 Nov. 2006, *S. Kern & A. Rea* 12086 (PERTH); Sep. 1990, *J.S. Pate s.n.* ♀ (PERTH (ex UWA)); 8 Oct. 1992, *J.S. Pate* 4093b (NSW); 7 Oct. 1995, *B.G. Briggs* 9389a, b *& J. Pate* (NSW).

Lectotypifications that designate illustrations

Chordifex isomorphus (K.W.Dixon & Meney) B.G.Briggs & L.A.S.Johnson, *Telopea* 8: 25 (1998). – *Restio isomorphus* K.W.Dixon & Meney, *Nuytsia* 9: 91, fig. 1 (1993). *Type citation*: 'Scott River along Governor Broome Road and Dennis Road (115° 17' E, 34° 15' S), December 1988, *Meney & Dixon* (KM 110, female plant), (holotype: PERTH; isotype: K, SYD)' [all lost]. *Lectotype,* here designated: illustration in Dixon *et al., Nuytsia* 9: 92, figure 1 (1993).

The representative specimen listed below is from the same broad location as the type collection.

Representative specimen: NNE of Augusta, Western Australia [precise locality withheld for conservation reasons], 11 Sep. 1990, *B.G. Briggs* 8676, *L.A.S. Johnson, K. Meney, P. Linder & J. Pate* ♀ (NSW 232888, PERTH 07953186).

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 11 Oct. 2002, *S. Barrett* 1014 (PERTH); 29 Aug. 1998, *B.G. Briggs* 9445 (NSW, PERTH); 8 Oct. 1984, *B. Briggs* 7648 *& L. Johnson* (NSW, PERTH); 9 Dec. 2003, *J.A. Cochrane* JAC 4824 (PERTH); 18 Jan. 2000, *N. Gibson & K. Dixon* 3823 (PERTH); 16 Nov. 1993, *N. Gibson & M. Lyons* 1543 (PERTH); Sep. 1990, *J.S. Pate s.n.* ♂, ♀ (UWA); 16 Sep. 2005, *E.M. Sandiford* EMS 1055 (PERTH).

Loxocarya magna Meney & K.W. Dixon, *Telopea* 6: 662–664, fig. 8 (1996). *Type citation*: 'Scott River,' [precise locality withheld for conservation reasons], '*Meney & Dixon KM 109*, 8 December 1988 (holotype KPBG; isotype PERTH)' [both lost]. *Lectotype,* here designated: illustration in Meney *et al., Telopea* 6: 663, figure 8 (1996).

The protologue states that *Loxocarya magna* was then only known from two small populations at Scott River and Ruabon. The representative specimen is from one of these sites. The different latitude and longitude coordinates given are not surprising with coordinates compiled from maps.

Representative specimen: ENE of Augusta, Western Australia (34° 14' S, 115° 16' E) [precise locality withheld for conservation reasons], 11 Sep. 1990, *B.G. Briggs* 8668, *L.A.S. Johnson, K. Meney, J. Pate & P. Linder* ♀ (NSW 232863, BOL, PERTH 02528347).

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 6 Nov. 2001, *J.A. Cochrane* JAC 3945 (K, PERTH); 11 Dec. 2001, *R.J. Cranfield* 17646B (CFR. MJP, PERTH); 22 Oct. 1997, *R. Davis* 4394 (PERTH); 19 Nov. 1991, *N. Gibson & M. Lyons* 1202 (PERTH); 11 Nov. 1993, *B.J. Keighery & N. Gibson* 563 (PERTH); 15 Oct. 1992, *B.J. Keighery & N. Gibson* 705 (PERTH); 29 Sep. 1990, *G.J. Keighery* 11769 (PERTH); 24 Sep. 1990, *G.J. Keighery* 12204 (CANB (*n.v.*), PERTH); 31 May 1995, *B.J. Lepschi* 1862 (CANB (*n.v.*), PERTH); Sep. 1993, *J.S. Pate s.n.* ♂, ♀ (UWA); 10 Sept. 1990, *C.J. Robinson 139* (PERTH); Capel, 7 Nov. 2006, *F. Smith* 44 (PERTH); 22 Oct. 1994, *C. Tauss* 44 ♂, 45 ♀ (UWA).

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The following people are thanked for their contributions to this paper: Gillian Perry, Nicholas Lander, Barbara Rye, Kevin Thiele, Paul Wilson and Juliet Wege for comments on the paper and perspectives on typification of names; staff at PERTH for access to the collections and FloraBase data; Bob Chinnock (while Australian Botanical Liaison Officer, Kew) for looking for the isotype of *Restio isomorphus* at K; Murray Henwood for looking for isotype material at the University of Sydney Herbarium (SYD); the Curators of KPBG, UWA and NSW for approval to transfer or divide relevant specimens so that lectotypes or isolectotypes could be placed in PERTH; Kingsley Dixon and Kathy Meney for discussions of the original specimens.

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New taxa in the *Leucopogon gracilis* group (Ericaceae: Styphelioideae: Styphelieae)

Michael Hislop

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983

Abstract

Hislop, M. New taxa in the *Leucopogon gracilis* group (Ericaceae: Styphelioideae: Styphelieae). *Nuytsia* 19(2): 211–228 (2009). Three new taxa, *Leucopogon paradoxus* Hislop, *L. tenuicaulis* Hislop and *L. elegans* Sond. subsp. *psorophyllus* are described. The first two of these are illustrated and the distributions of all three are mapped. A key is provided for all Western Australian taxa currently referred to the informal, subgeneric *Leucopogon gracilis* Group (*sensu* Hislop & Chapman 2007). Lectotypes are designated for the following taxa: *Leucopogon elegans* Sond., *L. gracilis* R.Br., *L. oppositifolius* Sond. and *L. oppositifolius* var. *pubescens* Sond.

Introduction

With only five published species, the *Leucopogon gracilis* group (Group E) is the smallest of the recently delineated (Hislop & Chapman 2007), informal, subgeneric groups within Western Australian *Leucopogon s. str.* All five species were named in the nineteenth century prior to the publication of Bentham's *Flora Australiensis* (1868). Brown (1810) described the first of these, *Leucopogon gracilis* R.Br., followed by two from Sonder (1845), *L. elegans* Sond. and *L. oppositifolius* Sond., with the Russian taxonomist Serge Stschegleew adding the other two, *L. gnaphalioides* Stschegl. and *L. lasiophyllus* Stschegl., in 1859. Bentham placed *L. oppositifolius* in series *Oppositifoliae*, and the rest in series *Concurvae*, despite noting the obvious similarities between *L. oppositifolius* and *L. lasiophyllus*.

The two new species from the group described in this paper have been recognised informally for a number of years and were treated in *Flora of the South West* (Wheeler *et al.* 2002). *Leucopogon paradoxus* Hislop was known by the name *Leucopogon* sp. Windy Harbour (A. Strid 21460), a phrase-name installed by Wheeler. *Leucopogon tenuicaulis* J.M.Powell ex Hislop was recognised under the same epithet, but as a Powell manuscript name. The third taxon, *Leucopogon elegans* Sond. subsp. *psorophyllus* Hislop, has been hitherto unrecognised.

Methods

This study was based on an examination of dried specimens housed at PERTH. The details of the methods used to measure plant parts and make other morphological observations are the same as those described previously (Hislop 2009), except in relation to the measurement of the inflorescence axis. The members of the *Leucopogon australis* group, described in earlier papers, have their upper

leaves and lower fertile bracts clearly dimorphic which allows the lower extremity of the inflorescence to be fixed at its insertion point in a leaf axil (where it is subtended by sterile bracts). Elsewhere in *Leucopogon s. str.* however, including the *Leucopogon gracilis* group, there is usually a gradual upward transition, at least on the main axes, from the lowest bracts which are indistinguishable from the upper leaves, to the upper bracts which are significantly different in shape and texture. For species with this inflorescence type the basal point of the inflorescence is taken to be the lowest fertile axil.

The distribution map was compiled using DIVA-GIS Version 5.2.0.2 and based on PERTH specimen data

A synopsis of and key to the *Leucopogon gracilis* group in Western Australia

Rootstock fire-sensitive; leaves spirally arranged or opposite, antrorse, usually steeply so; upper leaves and lower fertile bracts dimorphic or not; inner surface of corolla tube with 5 longitudinal interstaminal bands of hair extending from the base of the corolla lobes to a point ± level with the anther bases (in *L. paradoxus* the hairs are reflexed into the tube from a narrow, apical ring); abaxial surface of corolla lobes glabrous; ovary variously hairy (except in *L. gnaphalioides* where it is glabrous), 2-locular; nectary annular, lobed; drupes compressed, ellipsoid, narrowly ellipsoid, ovate or narrowly ovate, with 2 median longitudinal grooves, transversely elliptic in section, mesocarp very thin or apparently absent, the apex a fleshy appendage in all species except *L. paradoxus*, in which the apex is subacute with the appendage lacking; endocarp crustaceous.

1. Leaves always spirally arranged

2. Sepals to 1.2 mm long; corolla lobes to 1.2 mm long, corolla tube always manifestly longer than sepals; style 0.3–0.5 mm long, slender, deciduous in fruit; ovary hairs very short, restricted to two median longitudinal bands in the lower half (swamps between Witchcliffe, Augusta & Denmark) ..... **L. paradoxus**

2: Sepals at least 1.2 (usually > 1.5) mm long; corolla lobes >1.4 mm long, corolla tube length variable, relative to sepal length; style to 0.3 mm long, thick, persistent in fruit, although wholly or partially obscured by a terminal, rugose appendage; ovary hairs, if present, rather long and evenly distributed, at least in the lower half

3. Unit inflorescences aggregated into a dense terminal conflorescence; bracteoles 1.8–2.4 mm long; ovary glabrous (peaks of the Stirling Range) ..... **L. gnaphalioides**

3: Unit inflorescences not significantly aggregated, well differentiated from each other; bracteoles 0.8–2.0 mm long; ovary hairy, at least in lower half

4. Leaves sparsely arranged, 1–3 nodes per 1 cm of branchlet length (as measured immediately below the lowest inflorescence); inflorescences 11–28-flowered; flowers distinctly pedicellate, especially those in the lower half of the inflorescence; corolla lobe hairs 0.5–0.8 mm long (swamps from the Scott River Plain to the Whicher Range) ..... **L. tenuicaulis**

4: Leaves not sparsely arranged, 3–8 or more nodes per 1 cm of branchlet length; inflorescence 4–12-flowered; flowers sessile throughout inflorescence; corolla lobe hairs 1 mm or longer

5. Leaves usually glabrous, but if hairy then without long marginal cilia, very narrowly ovate or very narrowly elliptic, length to width ratio 5.4–12.2: 1, widest leaves <1.5 mm wide, usually < 1.2 mm, petiole rather obscure,to *c.* 0.7 mm long (Denmark to just east of Albany) ..... **L. gracilis**

5: Leaves usually variously hairy, occasionally glabrous, often with long marginal cilia, narrowly ovate to ovate, length to width ratio 2.2–4.5 : 1, widest leaves > 1.8 mm wide, usually > 2 mm, petiole broad and conspicuous, reddish or orange-yellow, variable in length but at least with some > 1 mm long

6. Adaxial leaf surface shortly and densely hairy, abaxial leaf surface often hairy; sepals 2.9–3.8 mm long, often hairy on abaxial surface; bracteoles 1.3–2.0 mm long (Wellstead to Cape Riche to the Pallinup River) ..... **L. elegans** subsp. **psorophyllus**

6: Adaxial leaf surface glabrous or very sparsely hairy towards the base, abaxial leaf surface glabrous; sepals 2.1–3.0 mm long, glabrous on abaxial surface; bracteoles 0.9–1.4 mm long (southern Stirling Range to Two People Bay to Cheyne Beach) ..... **L. elegans** subsp. **elegans**

1: All or at least some leaves opposite or sub-opposite

7. Abaxial leaf surfaces glabrous, or if rarely sparsely hairy, then the hairs not tubercle-based, the surface always smooth; calyx 2.1–3.0 mm long (Cranbrook to SW of Mt. Barker to Manypeaks, including the Stirling Range, also at Cape Arid National Park) ..... **L. oppositifolius**

7: Abaxial leaf surfaces with stiff, patent, tubercle-based hairs, these often abraded on older leaves, the surface remaining verrucose, although otherwise glabrous; calyx 2.9–4.5 mm long (Stirling Range) ..... **L. lasiophyllus**

Notes on the morphology and distribution of the *Leucopogon gracilis* group

The fruiting characters which in large part define the *Leucopogon gracilis* group are remarkably different from those of the four other infrageneric groups recognised by Hislop and Chapman (2007). In place of the tough, woody, fruiting endocarp which is otherwise typical of all western species of *Leucopogon s. str.*, members of the *L. gracilis* group have an endocarp which is thin and crustaceous, such that it may be readily breached by a thumb nail at maturity. Among western Styphelieae generally, a comparably brittle endocarp is otherwise seen only in a small, well-defined group of species related to *Leucopogon flavescens* Sond. in *Leucopogon s. lat.* In respect to other aspects of fruiting morphology however, the flattened drupes of the latter group are very different.

The development of a rugose, fleshy appendage at the drupe apex is also restricted to the *L. gracilis* group. In flower the ovary apex is demarcated from the usually short, thick style by the presence of a well-defined flange. As the drupe develops, fleshy tissue (presumably homologous to the mesocarp in a typical epacrid drupe) is produced vertically from about the flange to enclose the style base. At maturity this tissue may form a rim, above which only the stigma is visible (in *L. tenuicaulis*) or completely envelop the style and stigma (the remaining species). *Leucopogon paradoxus* lacks this apical appendage and has other morphological features which are anomalous within the group and even within the genus as a whole (as discussed below in the Notes section under that species). The presence of a well-defined stipe between the receptacle and the base of the mature drupe is another remarkable feature of the group.

In addition to these fruiting synapomorphies, members of the *L. gracilis* group also share an uncommon floral character. With the exception again of *L. paradoxus*, all species have more or less discrete, longitudinal bands of hair which extend from the base of the corolla lobes well into the tube. While species from other infraspecific groups may sometimes appear to be hairy in this region, closer

examination reveals that such hairs are reflexed into the tube either from the basal portion of the lobes or from a narrow ring of hairs at the tube apex.

The eight taxa which comprise the *L. gracilis* group are mainly distributed in near-coastal parts of the far south-west corner of Western Australia from the Whicher Range to the Pallinup River, west of Bremer Bay, and then with a disjunct occurrence well to the east at Cape Arid National Park. The furthest inland a member species (*L. oppositifolius*) has been recorded is from Hamilla Hill, north of the Stirling Range, about 100 kilometres from the south coast.

Taxonomy

Leucopogon elegans Sond. in C. Lehmann, *Pl. Preiss.* 1: 318 (1845). *Styphelia blepharophylla* F.Muell., *Fragm.* 6: 34 (1867). *Type*: In glareosis sterilibus collium Konkoberup, promontorii Cape Riche [near Cape Riche, Western Australia], 20 November 1840, *L. Preiss* 378 (*lecto*, here designated: MEL 76539!; *isolecto*: MEL 76540!).

Low, spreading *shrubs* to 50 cm high and 50 cm wide, although usually smaller, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* pale brown or reddish-brown, glabrous or with a sparse to dense indumentum of patent, straight or somewhat decurved hairs, usually of mixed lengths, to 0.6 mm long, which may persist in patches on the older stems. *Leaves* spirally arranged, steeply antrorse, narrowly ovate to ovate, 3.4–7.5(–9.8) mm long, 1.5–3.1 mm wide; apex acute; base cuneate or less often rounded; petiole broad, well defined, yellowish or orange-red, 0.5–1.6 mm long, glabrous throughout or sparsely to densely hairy on both surfaces; lamina 0.15–0.25 mm thick, strongly concave adaxially, longitudinal axis incurved, especially immediately above the petiole and towards the apex; surfaces discolorous, adaxial surface matt, pale green or glaucous, either entirely glabrous or with a few scattered hairs and 3–5 distinct, flat veins evident or else densely hairy throughout with a short, white, patent indumentum often obscuring the venation, abaxial surface darker, shiny, glabrous to moderately hairy, with 5–7 flat or slightly sunken veins, the midrib no more prominent than the others; the margins glabrous or ciliate with prominent hairs to *c.* 1.2 mm long. *Inflorescence* erect, terminal and upper-axillary; axis sometimes markedly flexuose, 3–11 mm long, with 4–11 flowers, terminating in an attenuate point or a bud-like rudiment; glabrous or with an indumentum of sparse to dense, patent hairs to *c.* 0.2 mm long, flowers erect and sessile. *Fertile bracts* narrowly ovate to ovate, varying significantly in size within each inflorescence, the lowest ones, at least on the primary axes, leaf-like (to *c.* 6 mm long and 2 mm wide), differing from the upper leaves in having longer petioles, above which the lamina is more abruptly incurved, diminishing in size through successive nodes, usually with only the uppermost small and typically 'bract-like' (the latter 0.8–1.4 mm long and 0.6–0.8 mm wide), sometimes all bracts leaf-like or in the case of the short upper-axillary inflorescences all may be small and 'bract-like'. *Bracteoles* ovate or narrowly ovate, 0.9–2.0 mm long, 0.5–1.0 mm wide, obtuse, subacute or acute, keeled, although sometimes rather obscurely; abaxial surface glabrous throughout or with a moderately dense indumentum of patent to shallowly antrorse hairs, usually greenish, sometimes suffused pink in the central portion, narrowly scarious towards the margins; adaxial surface glabrous throughout or sparsely antrorse-hairy; margins ciliolate although sometimes minutely so. *Sepals* narrowly ovate to narrowly elliptic, 2.1–3.5 mm long, 0.7–1.0 mm wide, acute or subacute; abaxial surface glabrous or with a sparse to moderately dense indumentum of patent to shallowly antrorse hairs, either greenish throughout the central portion or with the pale venation conspicuous and alternating with broader, green, interveinal bands, the whole sometimes suffused reddish in the upper half, narrowly scarious towards the margins; adaxial surface sparsely antrorse-hairy; the margins varying from minutely and sparsely to densely ciliolate and then with hairs

to *c.* 0.2 mm long. *Corolla tube* white or pink, narrowly campanulate, slightly shorter than to slightly longer than the sepals, 1.9–2.3 mm long, 0.8–1.2 mm wide, glabrous externally, internal surface with 5 longitudinal bands of hair extending from the base of the lobes to a point ± level with or a little below the anther bases. *Corolla lobes* white or pink, usually longer than the tube, less often about the same length or slightly shorter (ratio = 0.9–1.5: 1), widely spreading from the base and recurved, 2.1–3.0 mm long, 0.5–0.8 mm wide at base; glabrous externally, densely bearded internally, indumentum white, 1.0–1.4 mm long near apex; the glabrous tip very short *c.* 0.1 mm long. *Anthers* partially exserted from tube (by 1/8–1/4 of length), 1.4–2.2 mm long, prominently recurved at apex; sterile tips very long, 0.9–1.5 mm with conspicuous white apices. *Filaments* terete, attached 2/3–3/4 above anther base, very short, 0.1–0.2 mm long, adnate to tube just below sinus. *Ovary* slightly compressed, ovoid, 0.5–0.7 mm long, 0.4–0.5 mm wide with a moderately dense indumentum of appressed antrorse hairs in basal half, *c.* 0.2 mm long, 2-locular. *Style* 0.15–0.30 mm long, thick, papillose, included within the corolla tube; *stigma* slightly to distinctly expanded; *nectary* annular, 0.3–0.5 mm long, enveloping the lower 1/2–2/3 of the ovary, lobed for up to 1/2 of its length, the rim jagged and minutely ciliolate, otherwise glabrous. *Fruit* stipitate, compressed, narrowly ellipsoid, 2.4–3.0 mm long (including the stipe), 0.8–1.1 mm wide, longer than the calyx, the apex a fleshy rim produced vertically so as to completely obscure the style, sparsely hairy in the lower half, the surface smooth with a shallow, median, longitudinal groove; style persistent.

Notes. Leucopogon elegans is a variable species especially in regard to the presence, distribution and density of an indumentum on its vegetative parts. Two apparently parapatric subspecies are recognised based on bracteole and sepal length together with indumentum differences.

a. Leucopogon elegans Sond. subsp. **elegans**

Leucopogon elegans var. *glaucifolius* Sond. in C. Lehmann, *Pl. Preiss.* 1: 318 (1845). *Type*: Ad portum Regis Georgii, *L. Preiss s.n.* (*holo*: ?MEL, *n.v.*).

Illustration. Blackall & Grieve (1981: 329).

Leaves entirely glabrous, or the margins ciliate and either both surfaces glabrous, or the lower adaxial surface with a few hairs in the lower half. *Bracteoles* 0.9–1.4 mm long, obtuse to subacute, glabrous on the abaxial surface. *Sepals* 2.1–3.0 mm long, glabrous on the abaxial surface.

Selected specimens examined. WESTERN AUSTRALIA: 11 km E of Mt. Manypeaks, 20 Jan. 1997, *R. Davis* 2111 (PERTH); Moates Lake Reserve [N of Two Peoples Bay], 25 June 1990, *R. Fairman* 82 (PERTH); 20 miles [*c.* 32 km] NE of Albany on Hassell Hwy [South Coast Highway], 29 Mar. 1964, *A.S. George* 6163 (CANB, NSW, PERTH); Cheyne Beach [SE of Manypeaks], 28 May 1964, *A.S. George* 6288 (CANB, PERTH); 5 ½ miles [*c.* 8.8 km] E of Manypeaks, 10 Dec. 1964, *A.S. George* 6489 (NSW, PERTH); 17 miles [*c.* 27.2 km] E of Albany on road to Mt. Gardner, 8 Mar. 1967, *A.S. George* 8650 (NSW, PERTH); Takalarup Rd, *c.* 1.5 km E of Albany – Chester Pass Rd, E of Porongurup, 28 Sep. 1977, *A.S. George* 14943 (NSW, PERTH); Palmdale Rd, 9 km WNW of Manypeaks, 10 Nov. 1982, *G.J. Keighery* 5889 (CANB, PERTH); Herring Bay, Betty's Bay [Beach], 35 km E of Albany, 7 Aug. 1986, *G.J. Keighery* 8252 (CANB, PERTH); access track to Granite Hill Nature Reserve, 1.7 km E of Moorialup Rd, E of Porongurup, 16 Nov. 2003, *M. Hislop* 3094 (CANB, NSW, PERTH); close to corner of Bettys Beach Rd and East Bay Rd, N of Two Peoples Bay, 14 Feb. 2004, *M. Hislop* 3163 (PERTH); Waychinicup National Park, *c.* 1 km SW of Cheyne Beach settlement, 27 Aug. 2006, *M. Hislop* 3640 (CANB, PERTH); Channel Point [mainland adjacent to], Bald Island, 25 Oct 1971,

N.G. Marchant 71/720 (PERTH); 4 miles [*c.* 6.4 km] S of Mt. Toolbrunup [Stirling Range National Park], 30 Dec. 1962, *K.R. Newbey* 685 (PERTH); dune below granite rocks, above Cheyne Beach, 22 Aug. 1979, *J.M. Powell* 1294 (CANB, K, L, MO, NSW, PERTH, RSA); Two Peoples Bay Rd, 7 km E of Albany – Nanarup Rd junction, 29 Aug. 1986, *J.M. Powell* 2709 (HO, K, NSW, PERTH); 4 miles [*c.* 6.4 km] E of Kalgan River [NE of Albany], 30 July 1953, *R.D. Royce* 4268 (PERTH); Pfeiffer Rd [N of Manypeaks], 2 Sep.1965, *E. Wittwer* 510 (PERTH).

Distribution and habitat. Occurs sporadically from the southern Stirling Range southwards to Two Peoples Bay and is then locally common from there eastwards to the Cheyne Beach area (Figure 1). Grows in sandy soils in both dry and winter-wet heath and low woodland.

Phenology. Appears to flower intermittently throughout the year, and presumably fruit is also likely to be present in most months of the year.

Conservation status. Apparently well-conserved in a number of National Parks and Nature Reserves, where it is often locally common. No conservation coding is recommended at this stage.

Notes. As delineated here this taxon includes two more or less recognisable variants. The less common of these has vegetative parts that are glabrous, or almost so, and occurs in a restricted area mostly around Two Peoples Bay, in the south-western portion of the species' range. Type material of var. *glaucifolius* Sond. has not yet been located by the author, but it seems clear from Sonder's description that the name applies to this glabrous variant. There are, however, no co-relating floral or fruiting differences to support its taxonomic recognition and in any case a couple of collections (e.g. *E.J. Hickman* 6) do have a very sparse indumentum on the stems and leaf margins and so appear intermediate between the variants.

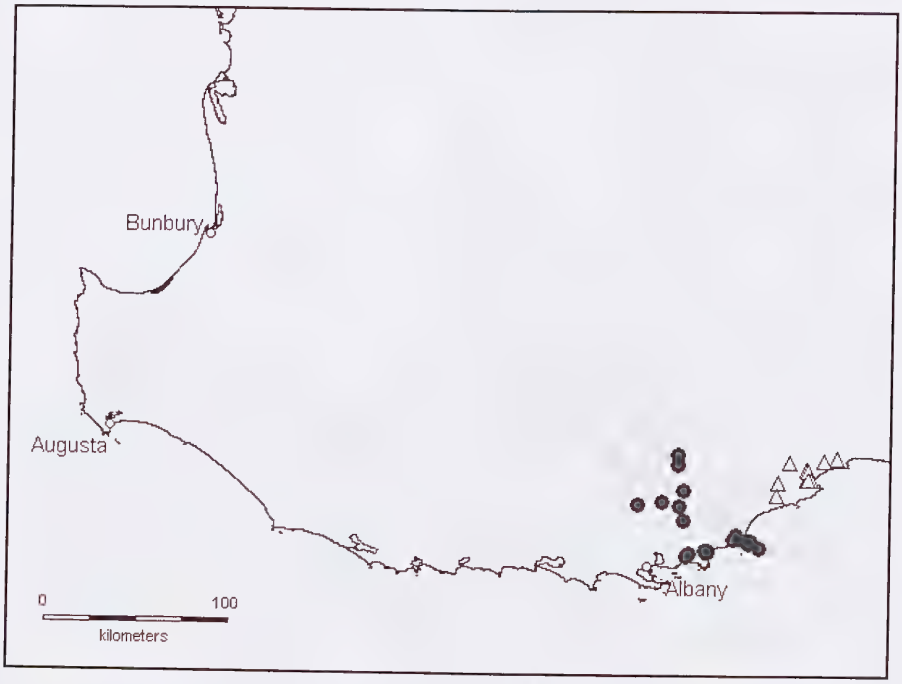

Figure 1. Distribution of *Leucopogon elegans* subsp. *elegans* (●) and *L. elegans* subsp. *psorophyllus* (△) in south-west Western Australia.

The type variant which occurs across the rest of the subspecies' range is characterized by the presence of an indumentum, at least on the inflorescence axes and usually on the stems, and in having long-ciliate leaf margins with or without a few hairs on the lower half of the adaxial surface.

Two collections (*R.D. Royce* 4268 & *E. Wittwer* 510) have longer than normal leaves (to 10 mm) and are also notable in being the only specimens with long, spreading hairs on the abaxial leaf surfaces. It seems probable that these were collected from juvenile plants. The Royce collection comprises four individual specimens, three of which have the leaf characteristics described above. In the case of the fourth specimen however, while the lower leaves are the same as the others on the sheet, the upper are shorter, glabrous on their abaxial surface and generally quite typical for subsp. *elegans*.

b. Leucopogon elegans Sond. subsp. **psorophyllus** Hislop *subsp. nov.*

A subspecie typico bracteolis et sepalis longioribus, pagina adaxiali foliorum pilosa differt.

Typus: West of Bremer Bay [precise locality withheld for conservation reasons], Western Australia, 2 October. 1974, *K.R. Newbey* 4464 (*holo*: PERTH 03132455; *iso*: AD, CANB, K).

Leaves ciliate or not, the adaxial surface with a moderately dense to dense indumentum of short, patent hairs throughout, the abaxial surface either with a sparse to moderately dense indumentum of patent hairs or glabrous. *Bracteoles* 1.3–2.0 mm long, subacute to acute, hairy or glabrous on the abaxial surface. *Sepals* 2.9–3.8 mm long, hairy or glabrous on the abaxial surface.

Specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 3–6 Mar. 1964, *W.H. Butler s.n.* (PERTH); 18 Mar. 1997, *R. Davis* 2893 (PERTH); 20 Oct. 1991, *W. Greuter* 23024 (PERTH); 7 June 2009, *M. Hislop* 3881 (PERTH); 7 June 2009, *M. Hislop* 3883 (CANB, NSW, PERTH); 26 May 1983, *G.J. Keighery* 6045 (CANB, PERTH); 24 Oct. 1996, *J.W. Mercer* 57 (PERTH); 1 Dec. 1974, *K.R. Newbey* 4634 (PERTH); 11 Nov. 1987, *K.R. Newbey* 11812 (PERTH); 16 Nov. 1985, *J.M. Powell* 3274 (HO, NSW, PERTH); 9 May 2003, *E.M. Sandiford* EMS 723 (PERTH); 9 May 2003, *E.M. Sandiford* EMS 735 (PERTH).

Distribution and habitat. Currently known to occur from a little west of Wellstead to Cape Riche to the Pallinup River (Figure 1). Grows in sandy soils, sometimes over laterite or spongolite, in heath or mallee woodland.

Phenology. The specimens examined were all collected between October and June, but given that the typical subspecies flowers throughout the year, it would not be surprising if some flowering also occurred in winter and/or early spring.

Etymology. From the Greek *psoro* (rough) and *phyllon* (leaf), a reference to the short, coarse indumentum which is always present on the upper and often also on the lower leaf surface.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority Three. This taxon appears to be very restricted geographically. It is known to occur in Mettler Lake Nature Reserve and the large Crown Reserve that extends between Cape Riche and Groper Bluff.

Notes. Although the type collections of *Leucopogon elegans* are certainly of the widespread variant of subsp. *elegans* discussed above, the locality given by Preiss (i.e. close to Cape Riche) is disjunct

for that taxon, but is within the distribution of subsp. *psorophyllus*. This anomaly may be the result of inaccurate record-keeping by Preiss, but if further collecting is able to demonstrate that the two taxa are indeed sympatric in the Cape Riche area, then it may be more appropriate to recognise the new taxon as a separate species.

Within *Leucopogon s. str.* (and elsewhere in the tribe Stypheliae) potential differences between taxa in terms of their vegetative indumentum, have to be treated with considerable circumspection. Many species are known to be very variable in this regard, and it is not uncommon to see mixed populations of conspicuously hairy and more or less glabrous individuals, with or without obvious intermediates. Nevertheless there is considerable evidence to suggest that the presence of a moderately dense to dense indumentum of short, antrorse or patent hairs on the adaxial leaf surface (of the kind seen in subsp. *psorophyllus*), is likely to be a reliable morphological character. It is for instance, always present in *Leucopogon oppositifolius* Sond., the most widespread species in Group E, as well as its close relative *L. lasiophyllus* Stschegl. In Group C it is a confirmatory character for *L. ozothamnoides* Benth. and at least one other unnamed taxon [i.e. *L.* sp. Burma Road (M. Hislop 2032)]. Away from *Leucopogon s. str.* it is consistently present in the widespread taxon *Leucopogon tamminensis* E. Pritz. var. *australis* E. Pritz., a member of the western 'Gynoconus' group of species (sensu Powell *et al.* 1997) in *Leucopogon s. lat.*

Leucopogon gracilis R.Br., *Prod. Fl. Nov. Holl.* 544 (1810). *Styphelia gracilis* (R.Br.) Spreng., *Syst. Veg.* 1: 658 (1824). *Type*: King George Sound [Western Australia], 11 December 1801–5 January 1802, *R. Brown s.n.* (*lecto*, here designated: BM 000929084!; *isolecto*: BM 000929086!).

Selected specimens examined. WESTERN AUSTRALIA: Ledge Beach Rd, Lower Kalgan, 9 Sep. 1983, *E.J. Croxford* 2666 (PERTH); Hooper Rd, 1 km from Lower King Rd, NE of Albany, 15 Dec. 1998, *E.J. Croxford* 8121 (PERTH); Denbarker State Forest, 'the Sand Track', 4.8 km W from Denbarker–Mount Barker Rd towards Stans Rd, 3 Sep. 1994, *B.G. Hammersley* 1124 (PERTH); Mt. Martin Botanical Park, off Spike Daniels track, NW of Dick Renshaw lookout [E of Albany], 20 Apr. 2003, *M. Hislop* 2940 (PERTH); Bakers Junction, 11 km NE of Albany, 10 July 1986, *G.J. Keighery* 8142 (PERTH); Gull Rock Rd, 4 km N of Gull Rock, E of Albany, 15 Aug. 1986, *G.J. Keighery* 8315 (PERTH); Millbrook Rd, 6 km ESE of junction with Albany Highway [N of Albany], 21 Aug. 1979, *J.M. Powell* 1279 (CANB, K, L, MO, NSW, PERTH, RSA); Granite Rd, 3 km N of Break Rd junction, *c.* 17 km NW of Denmark, 1 Feb. 1980, *J.M. Powell* 1433 (CANB, K, L, MEL, NSW, PERTH); Mt. Lindesay, track to summit area, NNW of Denmark, 3 Feb. 1980, *J.M. Powell* 1441 (K, MEL, NSW, PERTH).

Distribution and habitat. Leucopogon gracilis apparently has a disjunct distribution, with one node around Albany and another north of Denmark. It grows in sandy soils, often over granite, as a component of dry or winter-wet open woodland or heath.

Conservation status. Both of the population nodes are quite localized. Individual populations around Albany are likely to be threatened by the continued spread in that area of the root-rot pathogen, *Phytophthora cinnamomi* Rands., to which many epacrids are known to be susceptible (Keighery 1996), as well as ongoing urban development.

Notes. The Albany populations of the species, to which the type belongs, are invariably glabrous, while those from north of Denmark are either glabrous or more frequently with a sparse or moderately dense indumentum of patent hairs on the branchlets, inflorescence axes and abaxial leaf surfaces.

Leucopogon oppositifolius Sond. in C. Lehmann, *Pl. Preiss*. 1: 316 (1845). *Styphelia oppositifolia* (Sond.) F.Muell., *Fragm.* 6: 34 (1867). *Type*: Ad sinum Regis Georgii, Dec. 1840 et in Australia occidentali, *L. Preiss* 380 et 400 (*lecto*, here designated, *L. Preiss* 400: MEL 78367!). *Paralecto*: *L. Preiss* 380 (MEL 78366!).

Leucopogon oppositifolius var. *pubescens* Sond. [published as β *pubescens*] in C. Lehmann, *Pl. Preiss*. 1: 316 (1845). *Type*: In regionibus interioribus Australiae merid.-occid. m. Nov. 1840 [interior of south-western Australia, November 1840], *L. Preiss s.n.* (*lecto* here designated: MEL 78368!).

Selected specimens examined. WESTERN AUSTRALIA: S of Toolbrunup road, base of long ridge, SSE of Mt. Toolbrunup, 13 Oct. 2005, *S. Barrett* 1438 (PERTH); 10.8 km W of Chester Pass Rd on internal firebreak [Stirling Range National Park], 27 Mar. 2006, *S. Barrett* 1439 (PERTH); *c.* 1 km SW of Little Monderup [Stirling Range National Park], 16 June 2006, *S. Barrett* 1488 (PERTH); Mount Arid Rd, 3.6 km S of intersection with Merivale Rd (E side of road), 20 Oct. 1997, *E.A. Brown* 97/351, *P.G. Wilson & N. Lam* (CHR, NSW, NY, PERTH, UNSW); 2.2 km W of the Seal Creek camping area on the entrance road, Condingup [Cape Arid National Park], 7 Apr. 2007, *G. Byrne* 2615 (PERTH); Sheepwash State Forest on N boundary, 2 km E from Denmark–Mount Barker Rd, 14 Aug. 1993, *B.G. Hammersley* 898 (PERTH); W side of Surrey Downs Rd *c.* 1 km N of Mount Barker–Porongurup Rd, locality of Porongurup, 29 Dec. 2001, *M. Hislop* 2521 (NSW, PERTH); Hamilla Hill Nature Reserve, S boundary *c.* 2.5 km from SE corner, 30 Dec. 2001, *M. Hislop* 2531 (PERTH); Sukeys Peak [Sukey Hill], 8 km E of Cranbrook, 19 Aug. 1986, *G.J. Keighery & J. Alford s.n.* (PERTH); 0.2 km W of Chester Pass Rd on Stirling Range Drive, Stirling Range National Park, 19 Aug. 1979, *J.M. Powell* 1258 (CANB, K, L, MEL, NSW, PERTH); 11 km SW of Bluff Knoll turnoff, 2 km SW of Tolls Peak Rd on Chester Pass Rd, Stirling Range National Park, 19 Aug. 1979, *J.M. Powell* 1229 (CANB, K, L, MEL, NSW, PERTH); 3 km W of Mount Barker on Denmark road, 22 Sep. 1982, *A. Strid* 20387 (PERTH).

Distribution and habitat. This species has a remarkably disjunct distribution, with the main centre of occurrence from Cranbrook to just south of the Porongurup Range (there is an old record from Albany), and from the Denbarker area in the west to Two Peoples Bay. Over 400 kilometres to the east there is a second population node in the Cape Arid National Park. Grows in sand or sandy loam soils, sometimes over laterite or quartzite, in heath or open mallee woodland.

Conservation status. The western populations are conserved in the Stirling Range National Park, where it is still locally common, and in several other nature reserves. Its susceptibility to *Phytophthora cinnamomi* Rands is unknown, but if vulnerable, it is likely to suffer significant future decline in the Stirling Ranges where the root-rot pathogen now affects much of the park. Although the eastern population node is apparently quite localized, it occurs in remote country in the Cape Arid National Park and appears relatively secure.

Lectotypification. Of the two syntypes represented in Sonder's personal herbarium now at MEL, *Preiss* 400 is selected in preference to 380 because it is a single, good-sized specimen whereas the latter consists of four, smaller pieces. The locality information on both sheets is exactly the same as that given in the protologue, so there is some doubt as to which number is associated with which of the two cited (albeit vague) localities.

Affinities. Although he included *Leucopogon lasiophyllus* Stschegl. in his treatment of the genus, Bentham (1868) expressed doubts as to whether it was distinct from *L. oppositifolius*. He made the

comment that it only appeared to differ 'in the rather longer, more pubescent leaves, mostly alternate'. This view was apparently shared by Blackall and Grieve (1981) who also separated the two exclusively by foliar characters. With the benefit of the many additional collections that have been made in recent decades, together with field observations made by the author and Albany based Department of Environment and Conservation flora officer, Sarah Barrett (pers. comm.), there is now a stronger morphological and ecological basis for the continued recognition of two species. The combined sepal and leaf characters used in the above key will separate the two unequivocally in most cases. The very few specimens (e.g. A. Worz 04.11.01.07) that appear intermediate may be the result of limited introgression where the two species are growing in close proximity. Both species are locally common in the Stirling Range (*L. lasiophyllus* is endemic to the range) but generally occupy different habitats. *Leucopogon lasiophyllus* occurs high in the landscape, growing on mountain slopes in sandy loam or loam over quartzite or sandstone. *Leucopogon oppositifolius* on the other hand is usually found on the flats in deeper sand or sandy loam soils, although north of the Stirling Range at Hamilla and Sukey Hills it is known to grow in shallow soil over quartzite.

While the abaxial leaf surface in *L. oppositifolius* is consistently glabrous across most of the species' range, in populations around Mount Barker they are generally hairy. These plants look similar to *L. lasiophyllus* but the hairs are softer and not tubercle-based and the sepals are typical of *L. oppositifolius*. The morphology of the type of *L. oppositifolius* var. *pubescens* is very close to this variant of the species.

Notes. Given the exceptional geographical disjunction between the western and eastern populations of the species, it could be expected that some divergence would be evident. However there is little in the morphology to reflect this, other than a weak tendency towards smaller leaves in the eastern plants.

Leucopogon paradoxus Hislop, *sp. nov.*

Leucopogi gracili affinis sed sepalis brevioribus, tubo corollae longitudine sepala semper multo superans, stylo longiore angustiore, et pilis ovarii brevioribus ad lineam verticalem basin versus restrictis differt.

Typus: Denmark Shire, Watershed Rd, 0.5 km N from Break Rd [NW of Denmark], Western Australia, 24 October 1998, *B.G. Hammersley* 2069 (*holo*: PERTH 05333032; *iso*: CANB, NSW).

Leucopogon sp. Windy Harbour (A. Strid 21460), in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 240 (2000); in J. Wheeler, N. Marchant, & M. Lewington, *Fl. South West* 2: 599 (2002).

Erect, delicate *shrubs* to *c.* 50 cm high and 30 cm wide, but usually smaller, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* very slender, pale brown or yellowish-brown, glabrous, becoming overlain, though often rather sparingly, on older stems with grey, fissured bark, which sometimes exfoliates in fine hair-like strips. *Leaves* spirally arranged, steeply antrorse or antrorse-appressed and often ± stem-clasping, very narrowly ovate or very narrowly elliptic, 3.8–13.8 mm long, 0.5–1.4 mm wide; apex acuminate without callus tip; base attenuate or cuneate; petiole glabrous, usually very obscure to 0.3 mm long, or apparently absent; lamina *c.* 0.1 mm thick, strongly concave adaxially to ± involute, longitudinal axis slightly incurved towards apex; surfaces glabrous, ± concolorous, adaxial surface matt, with 1–3 sunken veins evident, abaxial surface with 3–5 conspicuous, pale, flat or slightly sunken primary veins, the midrib usually more prominent than

the others; margins glabrous, hyaline. *Inflorescence* erect, terminal and upper-axillary, the very short internodes of the flowering region, together with the short unit inflorescences, combining to produce a dense head-like conflorescence; axis often markedly flexuose, 1.5–4.0 mm long with 3–11 flowers terminating in a bud-like rudiment or an attenuate point; indumentum of sparse or moderately dense hairs to *c.* 0.1 mm long; flowers erect, sessile, densely clustered along axis. *Fertile bracts* narrowly ovate to ovate, the lower ones often leaf-like and much larger than the upper, 0.9–4.8 mm long, 0.4–0.7 mm wide, acute, subacute or obtuse; abaxial surface with obscure to moderately conspicuous venation, glabrous; adaxial surface glabrous or with a few hairs basally; margins ciliolate. *Bracteoles* broadly ovate, broadly elliptic or ± orbicular, 0.5–0.6 mm long, 0.4–0.5 mm wide, subacute to obtuse, rather obscurely keeled; abaxial surface glabrous, the central basal portion and main veins greenish-cream with darker green or reddish-purple interveinal stripes in the distal half, becoming pale and scarious towards margins; adaxial surface with a very sparse indumentum of antrorse hairs; margins ciliolate. *Sepals* ovate or elliptic, 0.8–1.2 mm long, 0.5–0.6 mm wide, subacute or obtuse, often very shortly apiculate, sometimes obscurely keeled towards apex; abaxial surface glabrous, the lower central portion and midvein greenish or greenish-cream, often flushed pink-purple distally, becoming paler and scarious towards the margins, the venation rather obscure apart from the midvein; adaxial surface with a very sparse indumentum of antrorse hairs; the margins ciliolate with hairs to *c.* 0.08 mm. *Corolla tube* white or pink, cylindrical throughout or slightly dilated in basal half and then cylindrical above, always longer than sepals (by up to 1.4 mm), 1.6–2.3 mm long, 0.6–0.8 mm wide, glabrous externally, internal surface with 5 tufts of reflexed hairs at the apex, which extend into the tube for at least 1/3 of its length, otherwise glabrous. *Corolla lobes* white or more often partially flushed pink, always shorter than the tube (ratio = 0.4–0.6: 1), widely spreading from base and ± recurved, 0.8–1.2 mm long, 0.4–0.5 mm wide at base; glabrous externally, densely bearded internally, indumentum white, 0.45–0.55 mm long near apex; the glabrous tip < 0.1 mm long. *Anthers* ± included within the tube, their apices held at the throat, 0.9–1.3 mm long, slightly recurved at apex; sterile tips very long and conspicuously pale towards the apices 0.6–0.8 mm long. *Filaments* terete, attached very close to apex, very short, *c.* 0.1 mm long, adnate to tube just above sinus. *Ovary* compressed ovoid, 0.6–0.8 mm long, 0.4–0.5 mm wide, with narrow median lines of very short hairs towards base, 2-locular. *Style* 0.3–0.5 mm long, very narrow cylindrical, papillose, included within the corolla tube; *stigma* distinctly expanded; *nectary* annular 0.2–0.3 mm long, usually acutely lobed for 1/2–3/4 of length, glabrous. *Fruit* shortly stipitate, slightly compressed, narrowly ellipsoid or narrowly ovate, straight or somewhat curved, 1.9–2.4 mm long (including the stipe), 0.5–0.7 mm wide, much longer than calyx, apex pale, subacute; surface smooth with two lateral ribs and two median longitudinal grooves, shortly hairy in the grooves at least in the basal half, otherwise glabrous; style deciduous. (Figure 2)

Other specimens examined. WESTERN AUSTRALIA: Kordabup Rd, [W of Denmark], 12 Sep. 1991, *A.R. Annels* 1656 (PERTH); 9.7 km WNW of Denmark. Timber Reserve 27398, 30 Aug. 1995 *A.R. Annels & R.W. Hearn* ARA 5402 (PERTH); E of western buffer, 300 m N of Scott River Rd, 31 Jan. 1997, *E. Bennett & B. Evans* SC 200.6 (PERTH); 200 m S of Mount Chudalup, 28 Oct. 1992, *M.D. Carter* 210 (PERTH); Windy Harbour, 6 Sep. 1995, *R.J. Cranfield* 10336 (PERTH); 7.4 km SSW of Stewart Rd on Milyeannup Rd [E of Augusta], 9 Oct. 2000, *R.J. Cranfield* 15550 (PERTH); 300 m along Nut Rd from junction with Ficifolia Rd, Walpole-Nornalup National Park, 10 Oct. 2003, *D.M. Crayn* 716, *K.A. Kron & A.J. Perkins* (NSW, PERTH, WFU); Cell 5, Site 165, Four Acres Rd, 2.4 km W of Tom Brittan Rd, bearing W, 20 Oct. 1998, *R. Davis* 7484 (PERTH); Scott River Rd, 0.1 km W of Milyeannup Coast Rd junction, on S side of road, Scott National Park, 22 Nov. 1989, *N. Gibson & M. Lyons* 290 (NSW, PERTH); E side of Scott River Rd, 0.3 km S of Governor Broome Rd intersection, Scott National Park, 24 Oct. 1990, *N. Gibson & M. Lyons* 1040 (PERTH); Northern boundary firebreak of Gingilup Swamps Nature Reserve, 3.5 km SE of the NW corner of the reserve, 20 Nov. 1991, *N. Gibson & M. Lyons* 1142 (PERTH); Collis Rd, 950 m N of Kangaroo Rd [N of

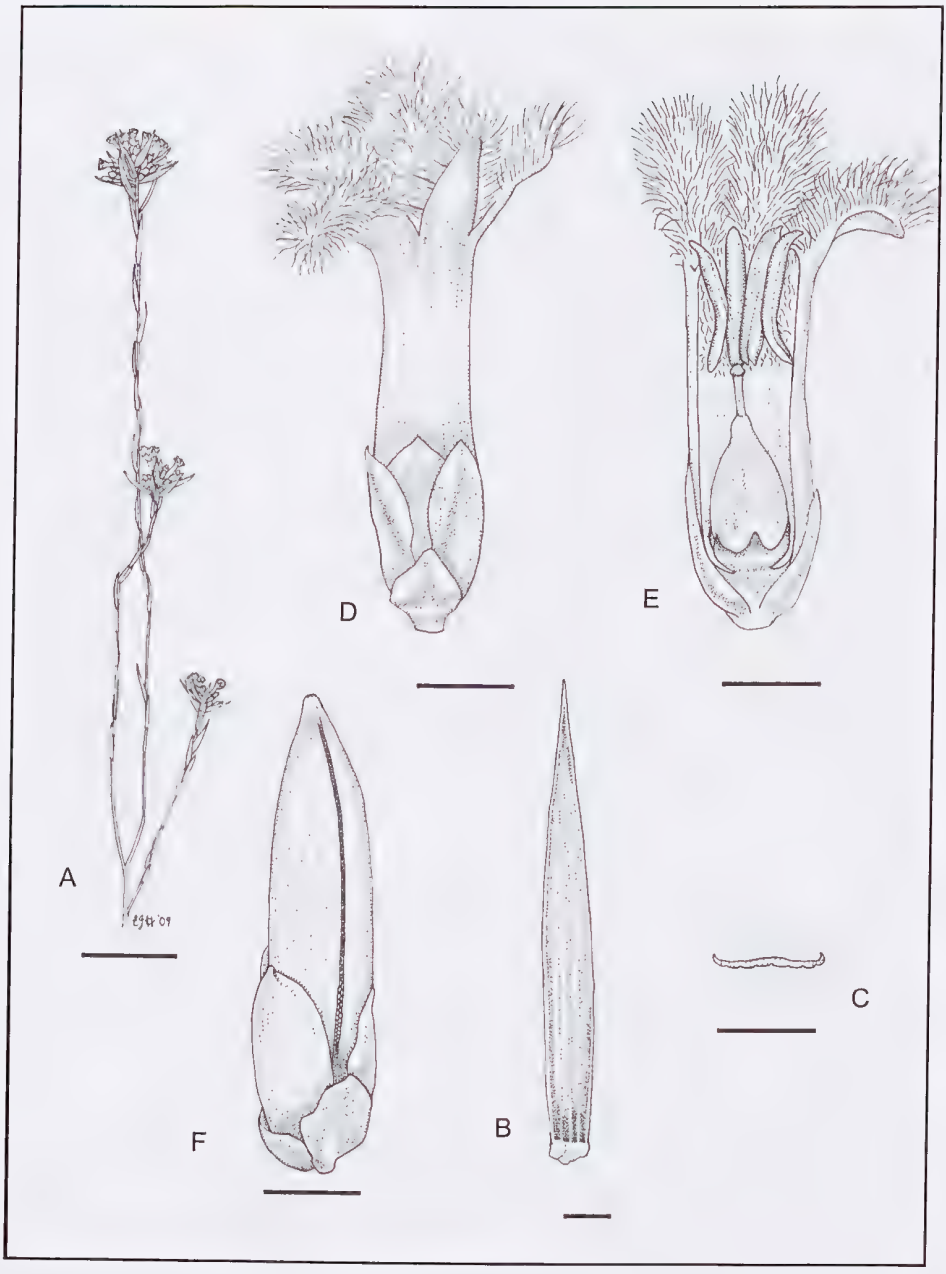

Figure 2. *Leucopogon paradoxus*. A – flowering branchlet; B – leaf, adaxial surface; C – leaf section; D – flower; E – flower, longitudinal section; F – fruit. Scale bars: A = 10 mm; B–C = 1 mm; D–F = 0.5 mm. Drawn by Ellen Hickman from *R.J. Cranfield* 15550 (A); *M.S. Graham* 851 (B–E); *N. Gibson & M. Lyons* 290 (F).

Walpole], 3 Oct. 1997, *M.S. Graham* MSG 851 (PERTH); S side of the South Western Highway, along a powerline right-of-way, *c.* 0.95 km W of junction with Coalmine Beach Rd, less than 1 km E of Walpole town limits, 8 Oct. 1999, *J.W. Horn* 2797 (CANB, DUKE, PERTH); Site 99, 8 km ENE of Augusta, 26 Aug. 1997, *P.A. Jurjevich* 660 (PERTH); Chester Block, Dennis Rd, Scott River, 26 Dec. 1990, *G.J. Keighery* s.n. (PERTH); Bell Brook Swamp, D'Entrecasteaux National Park, 6 Oct. 1997, *E.D. Middleton* EDM 54 (PERTH); Boatlanding Rd, [W of Pemberton], 12 Oct. 1985, *E. & S. Pignatti* 776 (PERTH); Scott National [Park], SECWA line to river, 24 Sep. 1990, *C.J. Robinson* 192 (PERTH); 1 km S of Forest Grove Rd [S of Witchcliffe], along National Park boundary track 13 Dec. 2000, *J. Scott* 358 (PERTH); Walpole–Nornalup National Park, Nut Rd, *c.* 0.8 km N of Ficifolia Rd, 16 Oct. 1991, *J.R. Wheeler 2793* (PERTH).

Distribution and habitat. Occurs between Witchcliffe, Augusta and the Denmark area (Figure 3) within 30–40 km of the coast. The species is restricted to low-lying, winter-wet sites in heath or open woodland communities, often in association with *Astartea* spp., *Taxandria* spp., *Beaufortia sparsa*, *Homalospermum firmum*, and various sedges and restiads.

Phenology. Flowers over an extended period between August and January, peaking between September and November. Fruit is usually present on herbarium specimens collected from October onwards.

Etymology. The epithet is from the Greek *paradoxos* (strange, contrary to expectation), a reference to some anomalous features of the floral morphology of this species, as discussed under the notes section below.

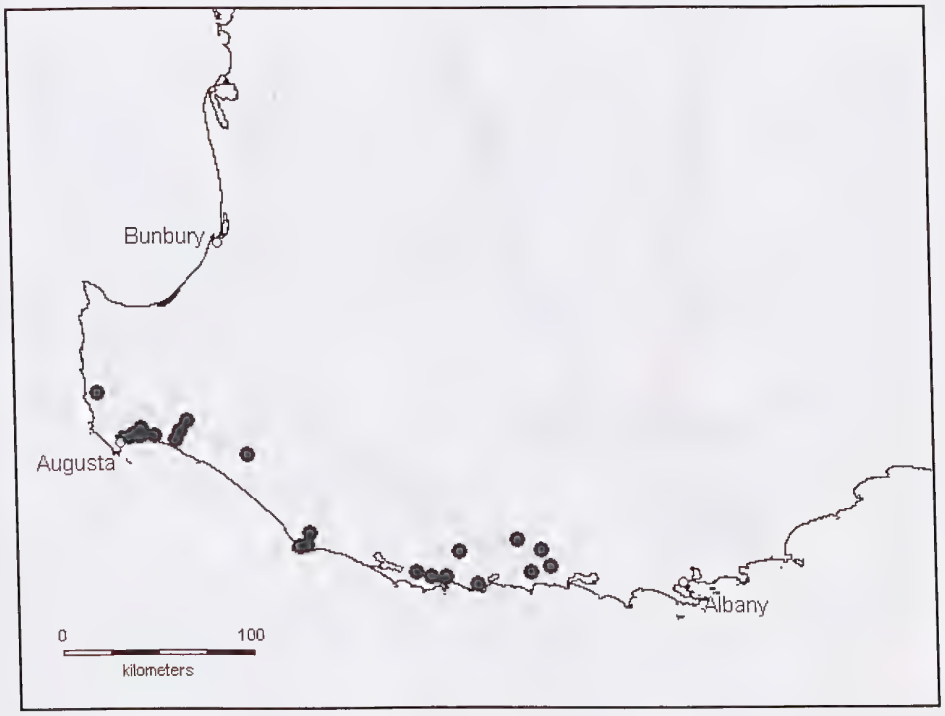

Figure 3. Distribution of *Leucopogon paradoxus* in south-west Western Australia.

Conservation status. *Leucopogon paradoxus* has a fairly wide regional distribution in near coastal parts of the far south-west and is well conserved in several National Parks and Nature Reserves where it is apparently locally common in suitable habitat. However it is restricted to one of the wettest districts of southern Western Australia and may become vulnerable in the medium term to the warming and drying effects of predicted climate change. Additionally its susceptibility to the fast-spreading root-rot pathogen *Phytophthora cinnamomi* Rands., has not been established, and many epacrids are known to be vulnerable (Keighery 1996). Although no conservation coding is recommended here, its status should be re-examined at intervals.

Affinities. Although a distinctive species in the detail of its floral and inflorescence morphology, it has been confused with two other slender, swamp-loving species – *Leucopogon tenuicaulis* J.M.Powell ex Hislop (described below) and especially *L. gilbertii* Stschegl. From the former *L. paradoxus* differs in its attenuate or cuneate leaf bases (usually cordate or rounded, rarely cuneate in *L. tenuicaulis*), sessile flowers (pedicellate), shorter corolla lobes, 0.8–1.2 (1.4–2.0), with a lower corolla lobe to corolla tube ratio, 0.4–0.6 : 1 (0.8–1.2: 1), and in having a longer, narrower style which is deciduous in fruit.

Leucopogon gilbertii shares the narrow, concave leaves and dense, head-like conflorescences of *L. paradoxus* but the two can be readily distinguished by differences in their corolla – *L. paradoxus* having a long, conspicuous corolla tube, always much longer than the sepals, whereas *L. gilbertii* has the tube about the same length as the sepals or shorter. The two have been observed by the author growing sympatrically on the Scott River Plains together with *L. wheelerae* Hislop. The sepal and fruit characters of *L. gilbertii* are interesting. The brown-coloured, narrowly obovate or elliptic sepals are quite unlike those of any other western member of the genus. Additionally the tiny, thin-walled, compressed-obovoid fruit is highly distinctive and does not suggest a particularly close relationship with any of the species groups delineated by Hislop & Chapman (2007).

Notes. Although common in *Leucopogon s. lat.*, the very long corolla tube, relative to the corolla lobes and sepals, is highly unusual in *Leucopogon s. str.* Among western species such an elongated tube is only otherwise seen in *L. verticillatus* R.Br. Even within Group E *L. paradoxus* is atypical in that it has a very slender, well defined style which is shed before the fruit matures. By contrast the other species have short, thick persistent styles, which are wholly or partially obscured by a fleshy appendage at maturity. In addition all members of the group except *L. paradoxus* have longitudinal bands of hair which extend into the corolla tube to a point more or less level with the base of the anthers. In *L. paradoxus*, although its hairy throat looks superficially similar, it actually has a narrow apical ring of hairs which are reflexed into the tube.

Leucopogon tenuicaulis J.M.Powell ex Hislop, *sp. nov.*

Leucopogi gracili affinis sed foliis maioribus sparsius distributis, basibus rotundatis vel cordatis non cuneatis, et floribus pedicellatis differt.

Typus: Milyeannup Coast Rd at Stewart Rd turnoff [SW of Nannup], Western Australia, 21 October 1993, *A.S. George* 17124 (*holo*: PERTH 04616065; *iso*: CANB, NSW).

Leucopogon tenuicaulis J.M. Powell ms, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 241 (2000); in J. Wheeler, N. Marchant, & M. Lewington, *Fl. South West* 2: 599 (2002).

Erect or ± sprawling, rather delicate *shrubs* to 50 cm and 50 cm wide, single-stemmed at ground level with a fire-sensitive rootstock. Young *branchlets* very slender, reddish-brown or yellowish-brown, glabrous, overlain on older stems with grey fissured bark which often exfoliates in strips. *Leaves* spirally arranged, steeply antrorse or antrorse-appressed, often ± stem-clasping at base, usually narrowly ovate or narrowly elliptic, occasionally narrowly obovate, 5–22 mm long, 1.7–5.2 mm wide; apex acute with a short, straight, pale, callus tip; base rounded or cordate, occasionally cuneate; petiole well defined, brown or reddish-brown, 0.4–1.1 mm long, glabrous; lamina 0.15–0.25 mm thick, strongly concave adaxially to ± involute; surfaces ± concolorous, adaxial surface matt, glabrous, venation not evident, abaxial surface glabrous, with 5–7 usually rather indistinct, flat, slightly raised or slightly sunken primary veins, the midrib no more prominent than the others; margins entire or ± crenulate, glabrous throughout or coarsely ciliolate with antrorse hairs especially towards apex. *Inflorescence* erect, terminal and upper-axillary; axis 5–19 mm long, with 11–28 flowers, terminating in a bud-like rudiment; indumentum of sparse to moderately dense patent hairs to *c.* 0.08 mm long; flowers erect, rather densely clustered along axis, pedicellate below the bracteoles for up to 1.4 mm and sometimes also above the bracteoles for up to 0.4 mm. *Fertile bracts* ovate, 0.8–1.3 mm long, 0.5–0.7 mm wide, obtuse to subacute; abaxial surface with moderately conspicuous venation, glabrous; adaxial surface with appressed hairs; margins minutely ciliolate. *Bracteoles* ovate, 0.6–1.1 mm long, 0.5–0.7 mm wide, acute, keeled; abaxial surface glabrous, the veins pale greenish-cream with reddish-purple interveinal stripes or the entire central portion greenish-cream which may or may not be suffused purple, becoming paler and scarious towards the margins; adaxial surface with very short antrorse hairs; margins ciliolate. *Sepals* ovate or narrowly ovate, 1.2–2.1 mm long, 0.6–1.0 mm wide, obtuse, subacute or occasionally acute; abaxial surface glabrous, the lower central portion uniformly greenish-cream, the venation usually conspicuous in distal half, greenish-cream with darker green or reddish-purple interveinal stripes, becoming paler and scarious towards the margins; the adaxial surface with short antrorse hairs; margins ciliolate with hairs to *c.* 0.1 mm long. *Corolla tube* white or pale pink, narrowly campanulate or ± cylindrical, always longer than the sepals (by up to 1.1 mm), 1.3–2.0 mm long, 0.9–1.1 mm wide, glabrous externally, internal surface with 5 longitudinal bands of hair extending from the base of the lobes to a point ± level with the anther bases. *Corolla lobes* white or partially suffused pink, slightly longer than to distinctly shorter than the tube (ratio = 0.8–1.2: 1), widely spreading from the base and recurved, 1.4–2.0 mm long, 0.5–0.7 mm wide at base; glabrous externally, densely bearded internally, indumentum white, 0.5–0.8 mm long near apex; the glabrous tip 0.1–0.2 mm long. *Anthers* partially exserted from tube (by 1/8–1/4 of length), 1.2–1.8 mm long, prominently recurved at apex; sterile tips 0.5–0.8 mm long with conspicuous white apices; *filaments* terete, attached 3/4–7/8 above anther base, very short 0.1–0.2 mm long, adnate to tube just below sinus. *Ovary* slightly compressed, ovoid, 0.4–0.5 mm long, 0.3–0.4 mm wide, with moderately dense antrorse hairs in basal half, *c.* 0.2 mm long, 2-locular. *Style* 0.2–0.3 mm long, thick, papillose, included within corolla tube; *stigma* slightly to distinctly expanded; *nectary* annular, 0.3–0.5 mm long, enveloping the lower 2/3–3/4 of the ovary, irregularly and usually acutely lobed for up to 1/2 of length, glabrous apart from a sparsely and irregularly ciliolate rim. *Fruit* stipitate, compressed, ovoid, straight or slightly curved, 1.8–2.1 mm long (including the stipe), 0.8–1.0 mm wide, longer than the calyx, the apex a fleshy rim produced vertically so as to obscure the style usually leaving only the stigma exposed at maturity; sparsely hairy in lower half, surface smooth with a shallow, median, longitudinal groove; style persistent. (Figure 4)

Other specimens examined. WESTERN AUSTRALIA: 900 m S of Brennans Ford on Scott River Rd then about 2.4 km W on track, then 20 m in from N side of track [NE of Augusta], 17 Dec. 1996, *A. Annels & C. Godden* SC 109.14 (PERTH); 2 km S along Scott River Rd from intersection with Brockman Highway [NE of Augusta], 10 Oct. 1997, *E.A. Brown* 97/264 *& G. Taaffe* (NSW, NY, PERTH, UNSW); Scott River – Flinders Bay district, 27 Dec. 1957, *D.M. Churchill s.n.* (PERTH 02355027); 5.2 km

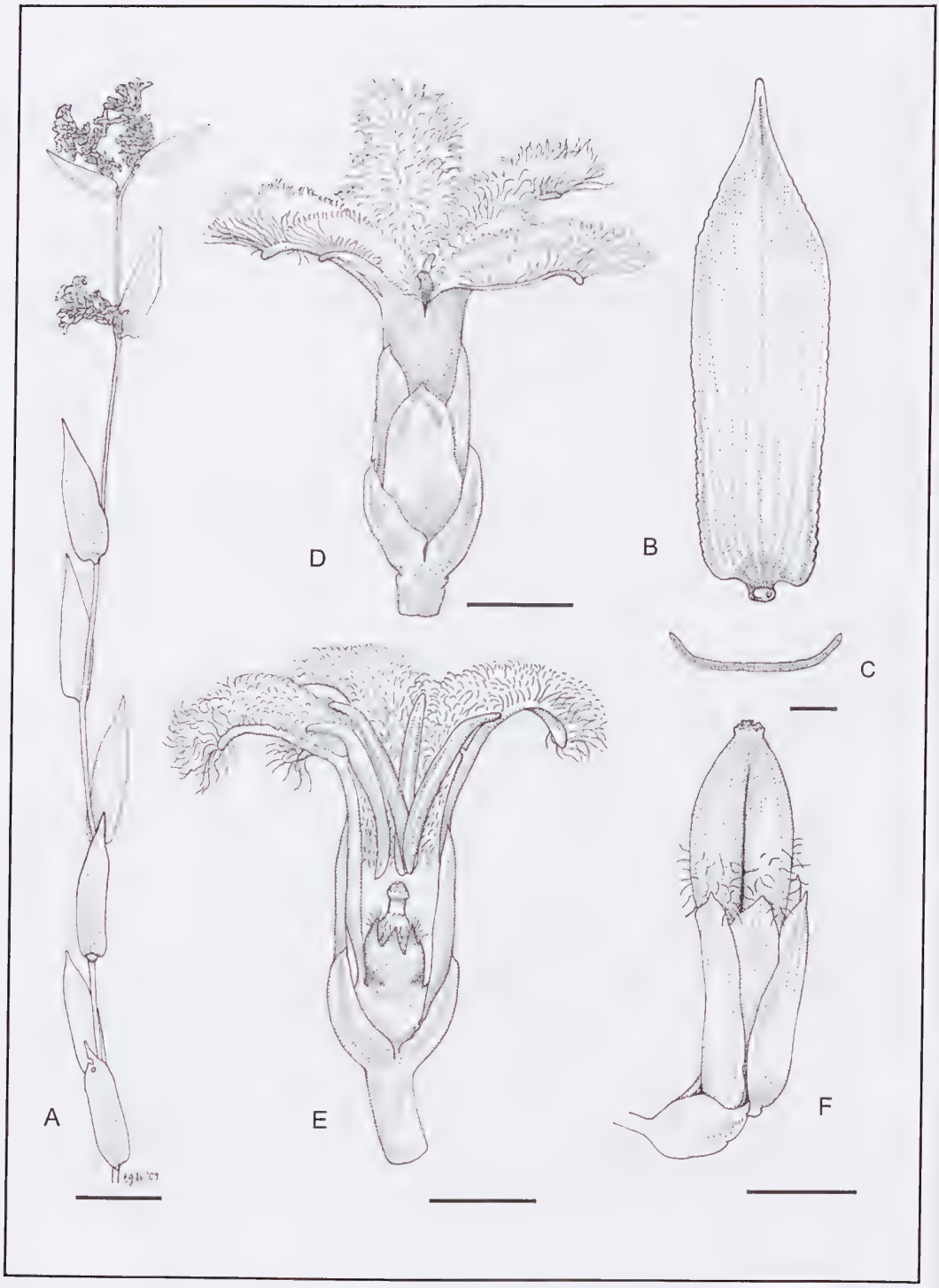

Figure 4. *Leucopogon tenuicaulis*. A – flowering branchlet; B – leaf, adaxial surface; C – leaf section; D – flower; E – flower, longitudinal section; F – fruit. Scale bars: A = 10 mm; B–F = 1 mm. Drawn by Ellen Hickman from *A.S. George* 17124.

ESE of Alexandra Bridge [NE of Augusta], 19 Sep. 1995, *R. Davis* 148 (CANB, PERTH); Blackwood River, *s.d.*, *J. Forrest s.n.* (MEL, PERTH); W side of Scott River Rd, 0.4 km S of Governor Broome Rd intersection, Scott River National Park, 24 Oct. 1990, *N. Gibson & M. Lyons* 1046 (PERTH); Site 99, 8 km ENE of Augusta, 26 Aug. 1997, *P.A. Jurjevich* 661 (PERTH); Williamson Rd, Willcox Block, Whicher Range, 28 July 1990, *G.J. Keighery* 11718 (PERTH); 3.1 km E of the Milyeannup Coast Rd and Stewart Rd intersection on S side of Stewart Rd [SW of Nannup], 19 Sep. 1995, *C. McChesney* CM 79 (PERTH); 3 km W of Brockman Highway & Milyeannup Coast Rd intersection on S side of Brockman Highway [W of Nannup], 4 Oct. 1995, *C. McChesney* CM 129 (PERTH); Quilergup [NW of Nannup], 2 Aug. 1972, *G.S. McCutcheon* GSM 392 (PERTH); Scott River Rd, 2.1 km from Brockman Highway [NE of Augusta], 24 Aug. 1986, *J.M. Powell* 2618 (NSW, PERTH); 2.7 km S from Brockman Highway on Scott River Rd [NE of Augusta], 9 Nov. 1985, *J.M. Powell* 3058 (HO, K, NSW, PERTH); 400 m S of McAtee Rd on Stoate Rd, then *c.* 300 m E to open heath, Helms Forest Block, NW of Nannup, 15 Aug. 2000, *L.W. Sage* 2370 (PERTH) Scott River National Park, along road to east Augusta, 4 Aug. 2007, *K.R. Thiele* 3306 (PERTH).

Distribution and habitat. The main centre of distribution for this species is on the Scott River flats to the north-east and east of Augusta, with a few populations known from further north, in the valleys of the Whicher Range (Figure 5). It is restricted to low-lying, winter-wet areas in heath or open woodland. Associated species include *Kunzea* spp., *Beaufortia sparsa*, *Pericalymma ellipticum* and numerous sedges and restiads.

Phenology. The main flowering period is between August and December, with fruit commonly present from October onwards.

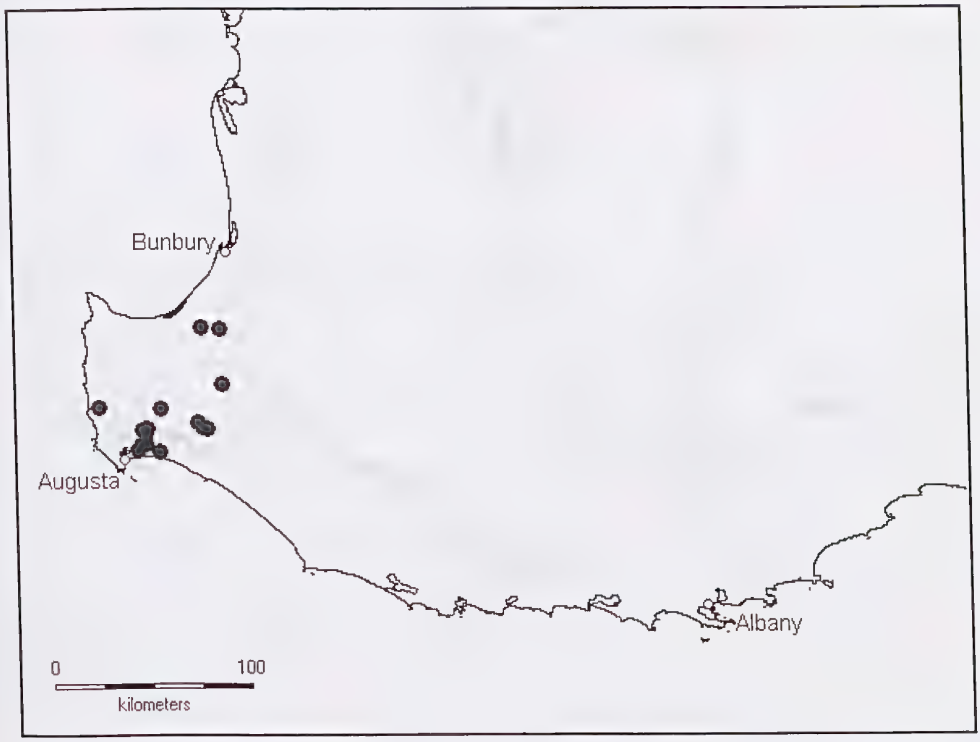

Figure 5. Distribution of *Leucopogon tenuicaulis* in south-west Western Australia

Etymology. The specific epithet is derived from the Latin (*tenuis* – narrow, delicate, and *caulis* – stem) and refers to the very fine branchlets that are a characteristic of the species.

Conservation status. Populations of this species are conserved in the Scott River National Park and the proposed Milyeannup National Park. As with *Leucopogon paradoxus* however, *L. tenuicaulis* is restricted to one of the wettest parts of south-western Australia, and although locally common it seems likely that it will be adversely affected by predicted climate change. This species is also known to be vulnerable to the root-rot pathogen *Phytophthora cinnamomi* Rands. The collection *L.W. Sage* 2370 represents a voucher specimen from an infected population, made during survey work by the Department of the Environment and Conservation's Dieback Hygiene & Mapping Service.

Affinities. Within the *Leucopogon gracilis* species group, *L. tenuicaulis* is most likely to be confused with *L. paradoxus* and *L. gracilis*. From the latter it is most easily separated by its generally larger, more sparsely distributed leaves, which have bases either rounded or cordate (on all or at least some leaves), rather than cuneate, and by the distinctly pedicellate flowers, especially those in the basal half of the inflorescence. Refer to the affinities section under *L. paradoxus* for differences between *L. tenuicaulis* and that species.

Acknowledgements

I would like to thank the following people for their help in putting this paper together: Sarah Barrett for her collections and observations of *Leucopogon oppositifolius* and *L. lasiophyllus* in the Stirling Range, Skye Coffey and Sue Carroll for technical assistance, Ellen Hickman for the excellent illustrations, Juliet Wege for nomenclatural advice and producing the distribution maps and Paul Wilson for providing the Latin diagnoses.

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Grevillea tetragonoloba (Proteaceae: Grevilleoideae) recircumscribed, with notes on its typification and a new segregate species, *Grevillea nivea*, described

Peter M. Olde[1] and Neil R. Marriott[2]

[1]138 Fowler Rd, Illawong, New South Wales 2234
[2]Box 107 P.O. Stawell, Victoria 3380

Abstract

Olde, P.M. & Marriott, N.R. *Grevillea tetragonoloba* (Proteaceae: Grevilleoideae) recircumscribed, with notes on its typification and a new segregate species, *Grevillea nivea*, described. *Nuytsia* 19(2): 229–243 (2009). *Grevillea nivea* P.M.Olde & N.R.Marriott is the third species that we have segregated and described from *Grevillea tetragonoloba* Meisner *sensu* McGillivray. The type citation of *Grevillea tetragonoloba* is discussed and modified. Recognition of *Grevillea nivea* as distinct from *Grevillea tetragonoloba* requires a modified circumscription for the latter species, and a full, updated description is provided here. A key is provided enabling distinction from closely related species.

Introduction

Grevillea tetragonoloba was described by C.F.Meisner (Meisner 1856: 374). Soon after its formal publication, Bentham placed it in synonymy under *Grevillea hookeriana* Meisner (Bentham 1870: 432). From that time, *Grevillea tetragonoloba* generally remained confused with *Grevillea hookeriana* until lectotypification of both species by Don McGillivray in 1993 (McGillivray & Makinson 1993: 420, 444) when they were re-established as distinct species. In the same monograph, McGillivray recognised *Grevillea tetragonoloba* as constituting five races (McGillivray & Makinson 1993: 71–72), leaving two specimens unassigned. All races are distributed in south-west Western Australia, roughly from the southern coast north to Woogenilup in the west and the Jerdacuttup River catchment near Ravensthorpe in the east. In 1994, the present authors revised the McGillivray arrangement. Three of McGillivray's races were formally recognised and described as two species and one subspecies, respectively 'race e', the short-lobed race *sensu* McGillivray, as *Grevillea fastigiata* P.M Olde & N.R.Marriott, 'race d', the digitate race, as *Grevillea rigida* P.M.Olde & N.R.Marriott subsp. *rigida*, and 'race c', the pectinate race, as *Grevillea rigida* subsp. *distans* P.M.Olde & N.R.Marriott (Olde & Marriott 1994d: 186–187). One unassigned specimen, *Rogerson* 332 (PERTH 02439603), was treated as an intermediate between the two subspecies of *Grevillea rigida*. Recognition of two races in a more narrowly circumscribed *Grevillea tetragonoloba* was continued (Olde & Marriott 1995b: 199–200). The two races retained were 'race a', the narrow-lobed race, and 'race b', the blunt-lobed race *sensu* McGillivray.

At that stage, 'race b' had not been seen by us in the field. The few dried specimens seen of 'race b' were mostly rudimentary. Our taxonomy was also confounded by living plants we had seen along West River Road, Fitzgerald River National Park that we assumed to be part of 'race b' (Olde 1988:

11) but which later proved to be a hairier, grey-leaved form of 'race a'. The misidentification led us to the belief 'that these two races do not warrant formal separation at this stage' (Olde & Marriott 1995b: 200). Makinson (2000: 72–74) continued recognition of the taxa erected by us but more correctly observed that *Grevillea tetragonoloba*, in which two forms were recognised, remained 'somewhat variable'.

Field work conducted by us in 1999 clearly showed correctly identified plants of 'race b' to be specifically distinct from 'race a'. In particular, we were struck by the snowy white indumentum on the branchlets, perianths and floral rachises, the bright red flowers and the coarser and more numerous leaf lobes, some with secondary division, all of which characters differed in populations of *Grevillea tetragonoloba*. It also confirmed conspecificity of 'race b' with a plant introduced to cultivation by John Cullen in 1992 from a plant collected at Hood Point (NSW 273561). The new introduction, here described as *Grevillea nivea* P.M. Olde & N.R. Marriott, has been sold as *Grevillea* 'Scarlet King'. Separation of 'race b' restricts the delimitation of *Grevillea tetragonoloba* yet further, and a full revised description is here included.

Grevillea tetragonoloba and *Grevillea nivea* are members of our Group 35 (the *Asplenifolia*/*Hookeriana* Subgroup of the *Pteridifolia* Group *sensu* Makinson 2000), a large group of grevilleas distinguished by having the ovary densely hairy, the adaxial surface of the perianth glabrous and fruits with reddish markings. Most of the group, though not all, have secund conflorescences and some have hairs behind the anthers.

Morphology and Terminology

Species description format and morphological terminology follow McGillivray and Makinson (1993), with some modifications based on Hewson (1988) and Hickey (1973). Our own modifications and clarifications to terminology, definition of species concept, and methods of working are outlined in Olde & Marriott (1993a, 1993b, 1994a, 1994b, 1994c, 1994d, 1995b, 2002, 2008). In this paper, we have prepared the descriptions initially from plants cultivated in the garden of one of the authors (Olde). These descriptions were then compared with dried specimens at CANB, MEL, NSW and PERTH and the descriptions modified where applicable. Herbarium abbreviations follow Holmgren *et al.* (1990).

Indumentum. Although the definitions of classical indumentum character states provided by Hewson (1988) are useful, we have come to the conclusion that, in most instances, they are too generalised to convey sufficiently precise information. McGillivray and Makinson (1993: 1–2) have described three types of hair in *Grevillea*, biramous, multicellular-glandular and papilloid. The first two types are uniseriate. Biramous or 'two-armed' hairs are restricted to the Proteaceae and are especially common in *Grevillea*. They have the ultimate of three cells two-branched, the arms equal or not in length, oriented at diagnostic angles, variable in thickness, shape, sheen and coursing and sometimes, with diagnostic colour content or colour changes. Multicellular or possibly sometimes unicellular, glandular hairs are simple, and may exude a viscous drop at the tip. After drying, they are scale-like, and often leave dried exudate in the form of resinous particles or, in one case described here, waxy globules. The presence or absence of glandular hairs is extremely diagnostic. Sometimes the two uniseriate hair types are mixed together in diagnostically important proportions and density. Hairs of different length and arm orientation may similarly be intermixed in diagnostic patterns. Classical terminology does not adequately address this variation. Weston (1994) used separate descriptive terms for each attribute

and, by following this, better discrimination between taxa has resulted in our work. Definitions of hair density, length, orientation are also provided by Weston. In measuring hair length we understand his definition of short, medium and long to refer to the length of both arms in combination. He has used the term 'curly' to describe biramous hairs without any specifiable angle, whereas we use this term when hairs are curled in circular formation. We use the terms 'wavy' or 'sinuous' when hairs exhibit undulate or irregular coursing or 'straight' when straight. When intermixed with biramous hairs, glandular hairs may be difficult to see if present in small numbers. They can be seen readily *in vivo*. In dried specimens, they can usually be recognised by their simple nature, their flatness or lack of body, their blunt tip or by attached, dried exudate, though care must be taken to distinguish this from sand and dirt particles.

Proximal rachis segment. In pinnatipartite (subpinnatisect) leaves the distance between the point of attachment of the petiole to the branchlet and the proximal lateral lobes has proved quite diagnostic. This section of what is the primary leaf rachis is here termed the 'proximal rachis segment'. In some groups of *Grevillea*, other characters have been introduced to further qualify this area of the leaf.

Conflorescence buds. Shape and size of floral buds is a neglected area of taxonomy in *Grevillea*. Buds constitute the primary phase of conflorescence development and close examination has proved to be extremely diagnostic in this and other species groups under study. The definition of a conflorescence bud is here restricted to the development phase when floral bracts firmly enclose the developing flowers. The bud begins to disintegrate as a recognisable unit when the bracts change orientation or fall and individual flowers elongate between them as they develop into a mature conflorescence. The point at which maximum bud maturity is reached occurs just prior to disintegration. In the current study this is achieved when elongation of the bud has reached *c*. 1.5 cm, at which length both shape and size are maximised and measurements have been made for comparison.

Pedicel. Pedicel width, not measured in any revisions to date, varies greatly between species, especially species groups, and may prove diagnostically useful. We have included this measurement as well as expanding the description of the pedicel itself.

Perianth limb. McGillivray and Makinson (1993: 2–4) recognised and illustrated three states of perianth orientation; erect, nodding and declined. In the *declined* position, depending on whether the curve or neck of the perianth tube elongates, the limb may turn down closely beside the perianth tube or through extension of the curve hang free away from the tube. In this context, we recognise the limb as either *closely declined* or *loosely declined*. We also recognise an additional state of recurvature, the *revolute* position, when the limb continues turning and the apex of the limb is directed at right angles back towards the ventral surface of perianth tube. Varying degrees of orientation are indicated by hyphenation e.g. declined-revolute, when the limb is not fully revolute but almost so.

Left and right. During ontogenetic development, the perianth limb may become laterally displaced from the dorsiventral axis of the perianth, either to the left or right. Accordingly, left and right are determined when the flower is held by the pedicel with the ventral suture facing away from the body, equivalent to stage-left in theatre i.e. to the left with respect to the performer, not the audience. In the same way, it may be diagnostically important to distinguish the sides of an irregular conflorescence. The left side of the floral rachis is determined similarly with the apex of the rachis facing away when holding it by the proximal, leafy end. Although floral orientation is said here to be acroscopic for both species, the dorsiventral axes of the perianths do not strictly face squarely towards the apex of the rachis but rather, face slightly to the left for flowers on the left of the rachis and slightly to the right for flowers on the right side of the floral rachis.

Taxonomy

1. Grevillea tetragonoloba Meisner, in A.L.P.P. de Candolle, *Prod.* 14: 374 (1856). *Type*: 'Swan R. Colony' [Western Australia], *Drummond* coll. 5 n. 282! (*lecto, fide* McGillivray in McGillivray & Makinson (1993: 444): NY 00284714, photo seen; *isolecto*: CGE (*n.v.*), Fl(*n.v.*), G (*n.v.*), K, LE (*n.v.*) MEL, NY 00284713, photo seen).

Grevillea tetragonoloba 'race a' the narrow-lobed race *sensu* McGillivray (McGillivray & Makinson 1993: 71–72).

Grevillea tetragonoloba fine-leaf (typical) form *sensu* Olde & Marriott (1995b: 200).

Grevillea tetragonoloba narrow-lobed form *sensu* Makinson (2000: 72–73).

Seedling (*McGillivray* 3511 NSW 297360) cotyledons not seen; branchlets with waxy globules; first three seedling leaves 2 cm long, 1 cm wide, obovate-cuneate, apically dentate, almost glabrous on both surfaces except for glandular excrescences and scattered appressed biramous hairs, the margins flat to shortly recurved; leaves 4–7 deeply pinnatifid to 3–5-partite, the lamina increasingly more deeply dissected with lobes narrow-triangular, and margins more strongly revolute; leaves 8+ closely approaching the adult, the lamina abutting the midvein on the abaxial surface, the sulcae sometimes filled with waxy globules. *Adult plants* stenobasic, fire-sensitive, dense *shrubs* 1.5–2.6 m high, 2–4 m wide with spreading to ascending branches; branchlets angular, becoming rounded with age, with prominent ribs decurrent from the leaf bases extending down past lower nodes; youngest branchlets striate, the indumentum creamy- or reddish-fawn to coppery with ferruginous ribs, greyish with age, dense between the ribs, sparse to moderately dense on the ribs, the hairs biramous and glandular, mostly short, straight or slightly sinuous, closely appressed and mutually aligned, with occasional hairs ascending. New growth fawn-brown. *Leaves* green, occasionally greyish, usually divided, rarely simple; divided leaves 6–13 cm long, 4–8 cm wide, strongly ascending, sessile to shortly petiolate, subsecund, gently incurved, wide-spaced to moderately crowded, obovoid in overall outline, most usually pinnatipartite with the proximal lobes lacking secondary division, the apical lobes sometimes bi- or tripartite; primary leaf lobes (2–)5–8; primary leaf lobes and simple leaves 2.5–7.5 cm long, (0.8–)1–1.5 mm wide, linear to subulate, straight to slightly incurved, tetragonous in cross-section, the terminal lobe simple or sometimes bisect; proximal rachis segment 1.5–4 cm long, linear; apices of lobes acute with blunt, scarcely pungent mucro 0.5–0.7 mm long; margin twice refracted about longitudinal intramarginal veins, the first refraction roughly at right angles, the second at right angles or oblique, usually enclosing the abaxial surface and either tightly abutting the midvein on the narrowest lobes or, on broader leaves, with a narrow (*c.* 0.05 mm wide) hair-lined sulca on each side of the midvein; adaxial surface usually convex, smooth, sometimes with irregular longitudinal wrinkling or ribs on either side of the midvein, subglabrous or with a sparse (moderately dense when young) indumentum of short, semi-appressed, white or rusty, wavy biramous hairs, occasional longer hairs and short glandular hairs or resinous deposits intermixed, the proximal rachis segment similar, the hairs dense on and just above the petiole; abaxial surface of lobes angularly concave to flat, enclosed by the margin, the midvein glabrous, or sometimes with a sparse indumentum of appressed, usually wavy, white or rusty hairs, sometimes hairs with black or red contents intermixed and mostly aggregated in the sulcae; venation of adaxial surface with the midvein and intramarginal veins translucent, prominently raised, smooth to faintly granular, on the abaxial surface the midvein prominent but recessed below the subtending intramarginal veins; texture coriaceous. *Conflorescence* 6–8(–10) cm long, 1–2 cm wide at anthesis but ultimately up to 5 cm wide post anthesis, 2.5–3 cm high *(in vivo)* from rachis to style-ends, terminal or more frequently subterminal, erect on the peduncle but usually

ascending relative to the shrub, usually simple, sometimes terminal conflorescences 1–3-branched at base, shortly pedunculate, narrowly conico-secund when the first flowers reach anthesis, later subhemispherical with the lateral flowers spreading in an almost horizontal plane, dense, acropetal; buds at 1.5 cm long, 2–2.5 mm wide, cylindrical; peduncles usually bracteate, 1–2 cm long, greyish-rusty, sericeo-tomentose with scattered glandular hairs intermixed; floral rachises 2–2.3 mm thick at base, striate, ferruginous alternating with white hairs, the latter colour predominant, silky-tomentose with glandular hairs and usually waxy globules *c.* 0.02 mm diam. intermixed, the apical 1 cm usually without flowers by abortion of young buds; conflorescence bracts 1.5–2.5 mm long, obovate; floral bracts *c.* 1 mm long, *c.* 2 mm wide, ferrugineo-sericeous outside, broadly obovoid with strongly incurved apex, glabrous inside, falling as the conflorescence expands. *Flowers* ferruginous on the limb in bud; at anthesis, the perianth outside grey-white with bronze-tinged hairs intermixed, limb ferruginous; perianth inside red at the curve and on dorsal tepals, elsewhere black-red; style yellowish above the ovary, Guardsman red (RHS 45A) elsewhere; style-end yellowish-red; pollen-presenter yellowish-red; pollen translucent with reddish tinges; nectary yellow with reddish infusion on exposed parts of the lower side, ageing to ochre-yellow; orientation in bud adaxially acroscopic, at anthesis acroscopic, post-anthesis adaxially acroscopic; pedicels 1.2–2 mm long, 0.7 mm wide at base expanding to 1 mm wide below the torus, recurved to erect before anthesis, ultimately strongly antrorse, stout, obovoid, tomentose with glandular hairs and waxy globules intermixed; torus 1.8 mm across, slightly oblique at *c.* 10° to transverse; nectary 0.7–1.5 mm long, 1.4 mm wide, 0.2–0.3 mm thick, patelliform-linguiform, concave proximally, extending *c.* 0.2–0.4 mm laterally beyond the torus, the apex truncate to broadly acute, recurved with age. *Perianth tube* 6–6.5 mm long, (1.8–)2–2.3 mm wide, zygomorphic, obliquely ovoid-sigmoid, dilated at base, the abaxial surface with a dense indumentum of biramous and scattered multicellular, glandular hairs intermixed with waxy globules, the hairs medium, dull to subshiny, straight, appressed; the adaxial surface glabrous, the style-end tightly enclosed before anthesis, all tepals separating and quickly falling after anthesis; limb 1.5–1.75 mm long, 1.8 mm wide, spheroidal, symmetrical, closely declined to declined-revolute, flowers on the left side of the rachis with limb sinistrally displaced at anthesis, those on right hand side dexterously displaced, sericeous to subsericeous with medium hairs bearing rusty contents; dorsal tepals 9.5–10 mm long, 1.5–1.7 mm wide at base, 0.7 mm wide at curve. *Pistil* 19–25 mm long; stipe 0.2–0.4 mm long, subvillous, mostly enclosed in the torus; ovary *c.* 1.3 mm long, *c.* 1.1 mm wide, obliquely ovoid, subsessile, densely subvillous with long, straight, slightly spreading, white hairs; style strap-like *in sicco*, terete *in vivo*, *c.* 0.7 mm wide at the curve, gradually dilated to 0.8 mm wide below the style-end, *in sicco* with few to many short multicellular trichomes especially at the half-way curve, *in hort.* (*Olde 08/01* [NSW], *Maiden s.n.* (NSW 92136) with numerous, short, simple, ?multicellular glandular hairs and minute trichomes throughout, glandular hairs moderately dense on the ventral surface about the curve, emergent and looped up before anthesis, erect with slight incurvature from *c.* halfway at anthesis but soon strongly retrorse from halfway to sigmoid, ultimately the proximal half of the style antrorse and slightly oblique to almost parallel with the rachis, the distal coursing unchanged; style-end abruptly divergent 0.5 mm below the end and expanded to 1.5 mm in width, glabrous; pollen-presenter 1.3 mm long, 1 mm wide, oblique at *c.* 5°–10°, encircled by an undulate style-end *in sicco,* round–elliptical, flat to slightly convex with one prominent radial rib extending proximally from the stigma and three distally, the margin and surface undulate; stigma prominent, annular, distally off-centre, surrounded by minute trichomes. *Fruits* 10–15 mm long, 5–7 mm deep, erect on strongly incurved pedicels, the dorsal suture adjacent to the rachis during the growth phase, ultimately rotating on its axis away from the rachis before dehiscence, obliquely ovoid–oblong to ellipsoid with erect or decurved apical attenuation *c.* 2 mm long; styles persistent; abaxial surface densely sericeous or subsericeous, glandular hairs or waxy globules very occasional to absent, longitudinally ribbed on the dorsal side and with irregular longitudinal, reddish-dark purple stripes confined to the dorsal side; surface beneath the indumentum slightly irregular and somewhat colliculose; adaxial surface smooth; pericarp 0.3–0.5 mm across at the suture, texture crustaceous. *Seeds* 8–10 mm long, 4 mm wide, 2 mm thick, obovoid-elliptical with

a curved outer edge and straight inner edge; abaxial face convex, glossy, almost smooth or slightly wrinkled, consisting of a central elliptic portion 7.5 mm long, 3.5 mm wide surrounded by a darker, narrow, rib-like border 0.25 mm wide and an outer, lighter-coloured margin 0.5–0.8 mm wide along the sides, up to 1 mm wide on the ends; adaxial face with an inner, flat, minutely tesselated, elliptic segment 7 mm long, 1.25 mm wide, surrounded by a dark border *c.* 0.3 mm wide, the border lacking vertically descending outer margin, all surrounded by a creamy-white waxy border *c.* 0.5 mm wide along the sides, 0.5–0.8 mm wide at base, the elaiosome 1–1.5 mm long and drawn to an obtuse point at the other end. (Figure 1)

Selected specimens (35 examined). WESTERN AUSTRALIA: Ongerup–Ravensthorpe Road, 25 km E of Ongerup, 17 Sep. 1990, *D.E. Albrecht & B.A. Fuhrer* 4516 (PERTH 04245113); intersection of Corackerup Rd & Cowalellup Rd, between South Stirling and Ongerup, 18 Feb. 1998, *L.W. Cayzer* 557, *G.T. Chandler & S. Donaldson* (AD, CBG 9805323, PERTH); Cape Riche Rd, off Hassell Highway, Wellstead, 14 Oct. 1988, *E.J. Croxford* 6113 (PERTH 04136926); 8 km E of Maringup South Rd [Maringarup Rd] and Devils Creek Rd junction, 28 km E of Gairdner, 30 Nov. 1985,

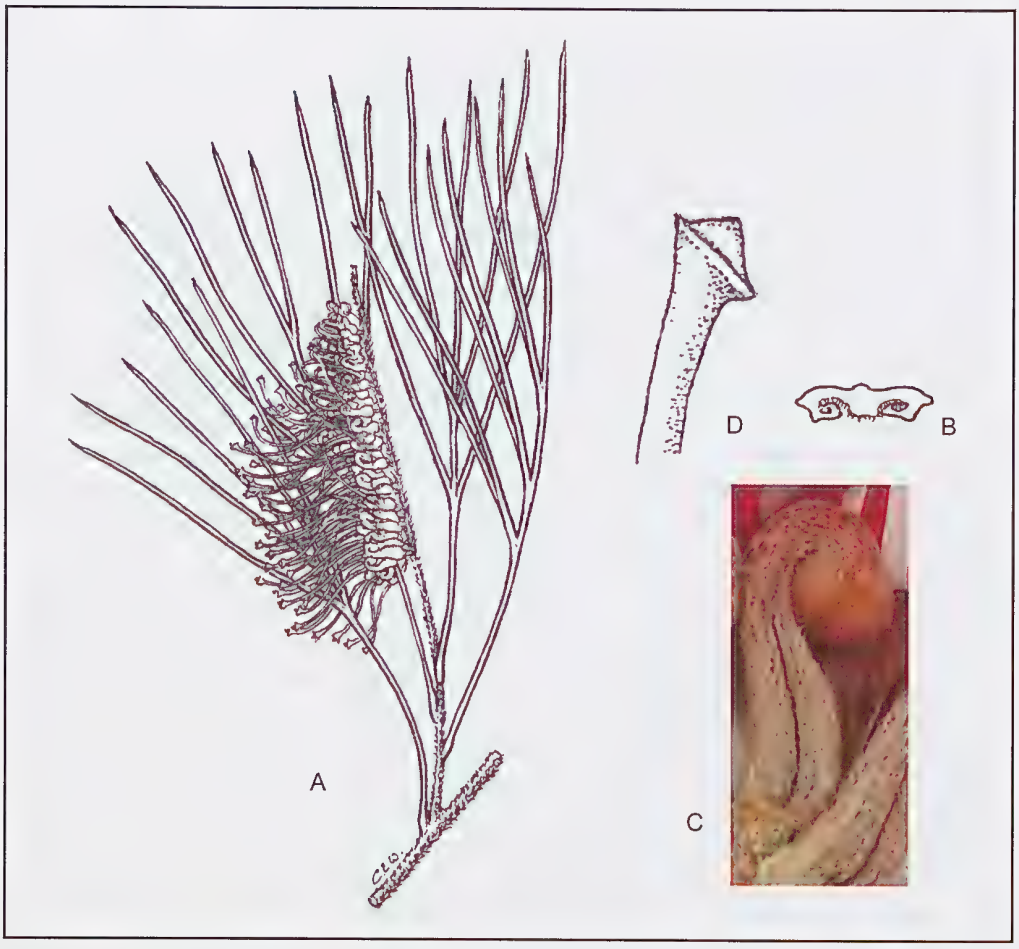

Figure 1. *Grevillea tetragonoloba*. A – unit conflorescence and foliage (×0.5); B – leaf lobe in cross-section (×20); C – perianth and pedicel, showing white, waxy globules around curve at top and on pedicel (×7); D – style-end (×15). Illustrations by the late Collin Woolcock. Colour image scanned with the assistance of Miguel Garcia and Paivi Lindsay at NSW.

D.B. Foreman 1361 (CANB 371641, NSW 388352, PERTH 1844083); near Cape Riche, 11 Oct. 1942, *C.A. Gardner* 6508 (PERTH 01844733); Hassell Highway, between the Boat Harbour turn-off and Pallinup River, *c.* 3 km S of the river, 25 June 1976, *D.J. McGillivray* DJM 3502 & *A.S. George* (CANB 00478043, PERTH 01844164); Melbourne Botanic Gardens, Sep. 1899, *J.H. Maiden s.n.* (NSW 92139); neighbourhood of Albany and King George's Sound, 1874, *G. Maxwell* 73 (NSW 399766 *ex Hb. J. Cosmo Melvill*); Needilup Hill, 6 Apr. 1963, *K. Newbey* 731 (PERTH 02439565); 11.3 km S on Toompup South Rd, Toompup, 11 Oct. 1991, *P.M. Olde* 91/293 (NSW 535412); Nyabing Rd, 25 km N of Jerramungup–Broomehill Road, 11 Oct. 1992, *P.M. Olde* 92/270 (NSW 535406); Knights Rd, Woogenilup, *c.* 10 km N of Porongurup, 18 Oct. 1999, *P.M. Olde* 99/300 & *P. Luscombe* (NSW 534612, PERTH 06487610); cultivated, Oakdale, New South Wales 18 Feb. 2008, *P.M. Olde* 08/01 (NSW); Hamersley Rd, Fitzgerald River National Park, 6 Dec. 1997, *R. Schuh* 97-18, *G. Cassis et al.* (PERTH 05099854); 16 km S of Jerramungup, 24 Oct. 1982, *A. Strid* 20992 (NSW 388351); W. Australia, 1896, *L. Webster per C. Walter s.n.* (NSW 92136).

Distribution. Western Australia, South-west Botanical Province, Esperance Plains IBRA. Most populations are within 50 km of Highway 1 between the points intersected by the Pallinup River in the west and West River in the east. Outlying populations are recorded from near Cape Riche and Woogenilup. (Figure 2)

Habitat. Occurs along open, rocky creek-lines or adjacent heath among granite boulders where it is usually dominant in shrubland.

Flowering period. Spring.

Fruiting period. Late spring–summer.

Conservation status. Conservation Code for Western Australia: Priority Two.

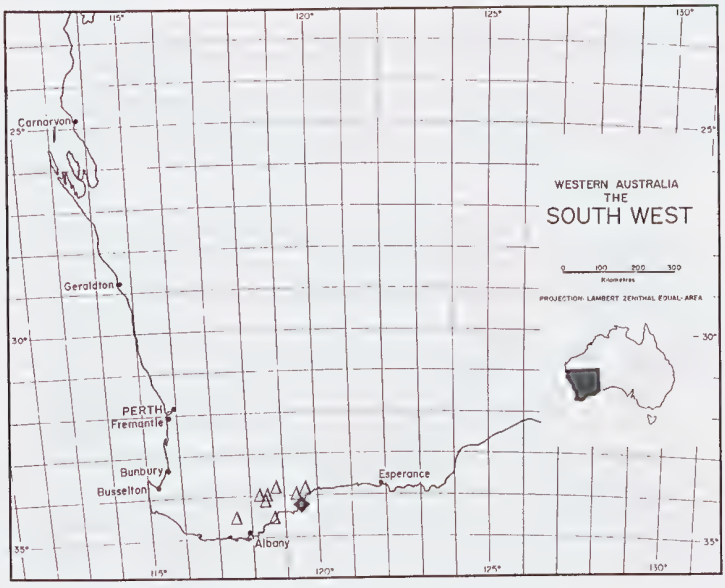

Figure 2. Distribution of *Grevillea tetragonoloba* (△) and *Grevillea nivea* (◆) in Western Australia.

Affinities. See *Discussion* under *Grevillea nivea,* its closest relative. *Grevillea tetragonoloba* has been confused with *Grevillea hookeriana*, which differs in having yellow-green leaves with smoothly revolute leaf margins and with the adaxial surface smoothly convex with venation obscure, pistils 18–21.5 mm long (except rarely a woodland population in Dryandra Forest to 23 mm long) and styles usually black or red-black, rarely yellow.

Note on typification. The name *Grevillea tetragonoloba* was first used by Meisner in 1852 within a long list of *Proteaceae* collected by James Drummond. The list was published in William Hooker's *Journal of Botany & Kew Gardens Miscellany* (Meisner 1852: 186). There the name, like many others, was a *nomen nudum* but Meisner indicated that the 'species and *var. ineditae* marked *MSS* 'would be 'found characterized in the forthcoming volume of De Candolle's *Prodromus*' (*ibid*: 182). The formalities were completed in 1856, as indicated (Meisner 1856: 374).

In an attempt to bring some order to Drummond's specimens, Meisner (1852) listed Roman numbers alongside each plant, according to the batch as they had 'successively been received in Europe'. To the collection of *Grevillea tetragonoloba* and others (e.g. *Grevillea armigera*) he erroneously recorded the Collection series as IV. Hooker submitted the list prior to publication to the Librarian of the Linnean Society, Richard Kippist (1812–1882) who, among other recommended changes, 'took 'the liberty of prefixing the date (1848) to those which I found marked in my list as belonging to the fourth collection.' (*ibid*: 181). The presumption that Drummond specimens collected in 1848 were part of his fourth collection continued until Erickson clearly demonstrated that it was part of his Fifth Collection, all specimens of which were despatched by Drummond in July 1849 (Erickson 1969: 168). The specimen was received in Europe (*nob. [nobis]* - to us) on 4 June 1850.

The lectotype (*fide* McGillivray, in McGillivray & Makinson 1993: 444) of *Grevillea tetragonoloba* is NY 00284714. There is also an isotype at NY. The only words attaching to the original type specimen were *Drummond ['Drumond'] 282!*. The protologue (Meisner 1856: 374 No. 100) of *G. tetragonoloba* adds the words *In colonia Swan River (Drumm. coll. 4, n. 282!).* At the end of the description Meisner cites specimens seen in the herbaria of Robert James Shuttleworth (1810–1874) and Dr Charles Morgan Lemann (1806–1852)(*v. s. in herb. Shuttl. et Lemann*).

The lectotype sheet itself now contains the following words, in Meisner's script:
Grevillea (*Calothyrsis*) *tetragonoloba nob. (4 Jun. 1850) Drummond* (Coll.1848) *n. 282! in hb. Shuttleworth.*

Notwithstanding Erickson's work, the lectotype of *Grevillea tetragonoloba* continued to be cited by all recent revisions as 'Swan R. colony, W.A. *J. Drummond* coll. 4, no. 282! (1848)' (McGillivray & Makinson 1993: 444; Olde & Marriott 1995b: 199; Makinson 2000: 72).

Drummond made several collecting trips to the south coast during his collecting career. All collections except his second and sixth contained specimens from the area. In addition to his famous collecting trip in 1846–47 with George Maxwell, after he had been awarded the Queen's Bounty, Drummond's 1848 expedition to almost the same area on the south coast was also made with George Maxwell (Olde & Viol in prep.). The collection citation *Drummond* Coll. 4, 1848 is therefore incorrect in two respects and should be modified, acknowledging Barker & Barker (1990), as 'Swan River colony, *Drummond [Drumond]* (Coll. V) n. 282! *& Maxwell* (1848)'.

It is interesting to note, among the general confusion, that other collections such as *Isopogon latifolius* and *Grevillea nudiflora* listed by Meisner (1852), which must have been made and sent at the same time as *Grevillea tetragonoloba*, were included in Collection V, according to the same list (Meisner 1852: 183, 186).

2. Grevillea nivea P.M. Olde & N.R. Marriott, *sp. nov.*

Affinis *Grevilleae tetragonolobae* Meisner sed pilis glanduliferis absentibus, ramulis niveis, foliis brevioribus (4.5–5.5 cm longis), lobis plerumque pluribus (9–15), brevioribus (1.5–4.5 cm longis), parum latioribusque (1.5–1.8 mm latis), ad basem 2–2.5 cm supra petiolos insertis saepe bi-divisis, sulcis abaxialibus circa 0.15 mm latis dense pilosis, apicibus obtusis, mucronibus brevioribus (0.3 mm longis), pilis rhachidum niveis, bracteis florum longioribus latioribusque (1.5 mm longis, 2 mm latis), globulis ceraceis in rhachidibus, pedicellis et perianthiis absentibus differt.

Typus: Doubtful Island Bay,Western Australia [precise locality withheld for conservation reasons], 18 October 1999, *P.M.Olde* 99/138 *& N.R. Marriott* (*holo*: PERTH 07862288; *iso*: AD, BRI, CANB, K, MEL, NSW, NY, PERTH 07862261, US).

Grevillea tetragonoloba 'race b' blunt-lobed race *sensu* McGillivray (McGillivray & Makinson 1993: 71–72).

Grevillea tetragonoloba blunt-leaf form *sensu* Olde & Marriott (1995b: 200).

Grevillea tetragonoloba blunt-lobed form *sensu* Makinson (2000: 41)

Seedling not seen. *Adult plants* stenobasic, fire-sensitive, dense *shrubs* 1.5–2.5 m high, 2–4 m wide with spreading to ascending branches; branchlets angular becoming rounded with age, with prominent ribs decurrent from the leaf bases extending down past lower nodes; youngest branchlets striate with ribs greenish (fewer hairs) or sometimes hairs with coppery tinges or not striate; indumentum dense, snow-white, greyish with age, the hairs biramous, mostly *medium*, straight or wavy, with some close-appressed and mutually aligned, some spreading to ascending. New growth soon greenish-white, very young shoots coppery. *Leaves* greyish, divided, 4.5–5.8 cm long, 3–4.5 cm wide, strongly ascending, sessile to shortly petiolate, subsecund, slightly incurved, crowded, obovoid in overall outline, subpinnatisect; proximal lobes simple or sometimes bi- or trisect; primary leaf lobes (3–)9–15, 1.5–4.5 cm long, 1.5 –1.8 mm wide, linear, straight to slightly incurved, tetragonous in cross-section, the terminal lobe simple; proximal rachis segment 1.5–2.5 cm long, linear, sparsely hairy to glabrous abaxially on the petiole; apices of lobes obtuse with short blunt mucro *c.* 0.3 mm long; margin twice-refracted at right angles about longitudinal intramarginal veins, the remaining lamina enclosing most of the abaxial surface and almost abutting the midvein, the two sulcae *c.* 0.15 mm wide; adaxial surface flat, channelled and with regular raised ribs between the midvein and margin or irregular longitudinal wrinkling on either side of the midvein evident, with an open to dense indumentum of medium, appressed, white, wavy hairs, the proximal rachis segment similar with a dense indumentum of curled and spreading hairs on and just above the petiole; abaxial surface flat, bisulcate, the sulcae densely packed with short, curled or wavy hairs, the midvein glabrous or sometimes with a moderately dense indumentum of appressed wavy hairs; venation of adaxial surface with midvein and two intramarginal veins translucent, prominently raised and smooth or faintly granular, on the abaxial surface the midvein prominent, level with or slightly above the margin; texture coriaceous. *Conflorescence* 8–10.5 cm long, 1–2.5 cm wide, 3 cm high (*in vivo*) from rachis to style-ends, terminal or more usually subterminal, erect on the peduncle

and striking an obliquely ascending angle relative to the branchlet, simple or sometimes the terminal conflorescence 1–3-branched from base, shortly pedunculate, conico-secund, dense, acropetal; buds at 1.5 cm long, *c.* 2.2 mm wide, cylindrical; peduncles usually bracteate, 1–2 cm long, snowy white to grey, sericeo-tomentose, the hairs biramous; floral rachises 3 mm thick at base, white, sub-villous, the apical 1 cm frequently without flowers by abortion of buds; conflorescence bracts *c.* 3 mm long, ovate; floral bracts *c.* 1.5 mm long, 1.5–2 mm wide, sericeous outside with a mixture of white and ferruginous hairs, very broadly obovoid to sub-elliptic with strongly incurved apex, glabrous inside, caducous as the conflorescence expands, some persistent at anthesis. *Flowers* in bud with the limb white to pale brown distally sometimes with red hairs intermixed, white proximally; at anthesis perianth outside snowy white to whitish red, limb whitish red to red-brown, perianth inside red to dark red; style and style-end currant red (RHS 46A); pollen-presenter orange-red; nectary creamy-yellow; orientation in bud adaxially acroscopic, at anthesis acroscopic, post-anthesis adaxially acroscopic; pedicels 2–2.5 mm long, *c.* 1 mm wide at base, 1.5 mm wide below the torus, recurved to erect at anthesis, strongly antrorse post anthesis, stout, obovoid, tomentose; torus *c.* 1.75 mm across, slightly oblique to *c.* 10°; nectary 1.3–1.4 mm long, *c.* 1.25 mm wide, *c.* 0.4 mm thick, patelliform-linguiform, concave proximally, extending *c.* 0.3 mm laterally beyond the torus, apex truncate to broadly acute, recurved with age. *Perianth tube* 6.5–8 mm long, 2–2.5 mm wide at base, *c.* 1.5 mm wide at curve, zygomorphic, obliquely ovoid-sigmoid, dilated slightly at base, the abaxial surface with a dense biramous indumentum, the hairs medium, dull, sinuous, antrorsely spreading at *c.* 10°–20°, the adaxial surface glabrous; limb 1.8–2.25 mm long, 1.8–2.5 mm wide, spheroidal, symmetrical, closely declined to declined-revolute, flowers on the left side of the rachis sinistrally displaced at anthesis, those on the right dexterously displaced, the hairs medium-long bearing pale, fawnish-brown contents, the style-end tightly enclosed before anthesis, all tepals separating and quickly falling after anthesis; dorsal tepals *c.* 10.25 mm long, 1.5 mm wide at base, 0.5–0.7 mm wide at curve. *Pistil* 22–24.5 mm long; stipe *c.* 0.2 mm long, subvillous, the portion enclosed in the torus glabrous; ovary *c.* 1 mm long, *c.* 1.5 mm wide, obliquely ovoid, subsessile, densely subvillous with hairs long, straight, white, slightly spreading; style strap-like *in sicco*, terete *in vivo*, *c.* 0.7 mm wide at the curve, gradually dilated to 0.9 mm just below the style-end, usually glabrous, occasionally with scattered minute trichomes of uncertain type at the curve on the ventral side, emergent and looped up before anthesis, gradually incurved at anthesis, strongly retrorse from halfway to sigmoid soon after anthesis, ultimately the proximal half of the style antrorse and slightly oblique to almost parallel with the rachis, the distal coursing unchanged; style-end abruptly divergent 0.7 mm below the end and expanded to *c.* 1.6 mm in width, glabrous; pollen-presenter 1.5–1.6 mm long, *c.* 1.25 mm wide, oblique at 10°–30° encircled by an undulate style-end *in sicco*, oblong-elliptic, convex with one prominent radial rib extending proximally from the stigma and a few distal ribs faintly raised; stigma prominent, oblique, annular, distally off-centre, surrounded by minute trichomes. *Fruits* 14–17 mm long, 6–7 mm deep, erect on strongly incurved pedicels, the dorsal suture adjacent to the rachis during the growth phase, ultimately rotating on its axis away from the rachis before dehiscence, obliquely ovoid to oblong-ellipsoid with erect or decurved apical attenuation *c.* 2 mm long; styles persistent; abaxial surface openly sericeous, longitudinally ribbed on the dorsal side, with irregular, longitudinal, dark reddish-purple stripes predominant toward the dorsal side; surface beneath the indumentum slightly irregular and somewhat colliculose; adaxial surface smooth; pericarp 0.4–0.5 mm across at the suture, texture crustaceous. *Seeds* 8–10 mm long, 4–4.5 mm wide, 1.7–2 mm thick, obovoid-elliptical with a curved outer edge and straight inner edge; abaxial face convex, glossy, almost smooth or slightly wrinkled, consisting of a central elliptic portion 7 mm long, 2.5 mm wide surrounded by a darker narrow rib-like border 0.25 mm wide and an outer, lighter-coloured margin 0.5–1 mm wide along the sides, up to 0.7–1 mm wide on the ends; adaxial face with an inner, flat, minutely tesselated, elliptic segment 6–7 mm long, 1.5–2 mm wide, surrounded by a raised border *c.* 0.5 mm wide, the border with an irregular and sometimes vertically descending outer margin and all surrounded by a creamy-white waxy border *c.* 0.5 mm wide along the sides, *c.* 1 mm wide at base, the elaiosome 1–1.5 mm long and drawn to an obtuse point at the apex. (Figures 3, 4)

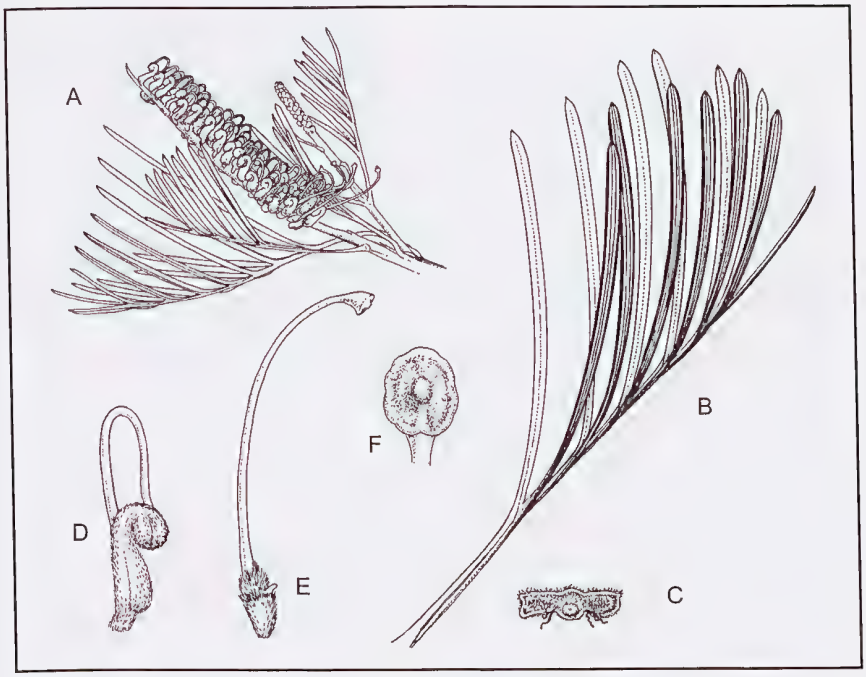

Figure 3. *Grevillea nivea*. A – conflorescence and bud with foliage (×0.5); B – leaf (×2); C – cross-section of leaf lobe (×10); D – perianth and style prior to anthesis (×2); E – pedicel and pistil (×2); F – pollen-presenter (×9). Illustrations by Margaret Pieroni.

Figure 4. *Grevillea nivea* in cultivation, October 2008, at 'Silky Oaks', Oakdale, New South Wales.

Selected specimens (9 examined). WESTERN AUSTRALIA: Gairdner River, 28 July 1963, *J.S. Beard* 2564 (KPBG); cultivated Botanic Gardens (?Sydney), Nov. 1909, *J.L. Boorman s.n.* (NSW 921138); Hood Point, Bremer Bay, 1 Jan. 1993, *J.M. Cullen* 92098 (NSW 273561); Bremer Bay, high sandstone heath, 1 Nov. 1943, *C.A. Gardner* 6578 (PERTH 02142910); Doubtful Is. [Island] Penin[sula], undated, *Anon.* [*G. Maxwell*] 246 (MEL 64565, MEL 64566); Doubtful Island Bay, undated, *Oldfield s.n.* (MEL 64568); Bremer River, 1884, *W. Webb s.n.* (MEL 64569); Bremer Bay, S Coast, Sep. 1897, *J. Wellstead s.n.* (CANB 327763).

Distribution. Western Australia, South-west Botanical Province, Esperance Plains IBRA Region, southern coast between Point Hood and Gairdner River. (Figure 2)

Habitat. Occurs as a dominant in open, low, windswept heath on hillside among granite rocks close to the coast.

Flowering period. Spring.

Fruiting period. Late spring–summer

Conservation status. Conservation Code for Western Australia: Priority Two.

Etymology: The specific epithet is derived from the Latin, *niveus* – snow-white, in reference to the branchlet, perianth and floral rachis indumentum.

Discussion. Grevillea nivea may be best summarised in terms of the following characters; branchlets snowy-white, the hairs medium in length, mostly appressed but some spreading, biramous; leaves greyish, divided, never simple, with 9–15 closely-aligned, linear lobes, the proximal rachis segment 1.5–2.5 cm long; leaf lobes 1.5–4.5 cm long,1.5–1.8 mm wide, the proximal lobes simple to bi- or trisect, the adaxial surface with a moderately dense indumentum of medium, biramous hairs; the abaxial surface flat, the midvein and intramarginal veins equally prominent in cross-section; margin twice-refracted at right angles, the ultimate refraction level with the midvein; sulcae beside the midvein on the abaxial surface of leaf lobes *c.* 0.15 mm wide, densely covered in wavy hairs; apices of lobes obtuse with mucros *c.* 0.3 mm long; floral bracts *c.* 1.5 mm long, 1.8–2 mm wide; floral rachises, pedicels and base of perianth lacking white waxy globules or irregular glandular excrescences in the indumentum; principal flower colour red; floral rachis snow-white; perianth indumentum snow-white, antrorsely spreading; perianth limb white with a few brownish hairs; style glabrous.

The morphological characters that best summarise *Grevillea tetragonoloba* are: branchlets with hairs non-white, usually creamy-brown or honey-coloured, with an indumentum of short, appressed, biramous and glandular hairs intermixed; leaves usually green, occasionally grey-green, rarely simple, usually divided with 5–7(–8) loosely spreading to aligned, narrow-linear lobes, the proximal rachis segment 3–5 cm long; leaf lobes 3–8 cm long, 0.8–1.5 mm wide, the proximal lobes simple, the adaxial surface subglabrous or with a sparse, mixed indumentum of short, biramous and glandular hairs, the abaxial surface usually angularly concave, the midvein recessed below the intramarginal veins; margin twice-refracted, the first refraction at right angles, the ultimate refraction usually oblique; sulcae beside the midvein on the abaxial surface of leaf lobes scarcely evident to very fine, *c.* 0.05 mm wide, hairs either not visible or, occasionally, appressed straight hairs visible; apices of lobes acute, with mucros 0.5–0.7 mm long; floral bracts *c.* 0.8 mm long, 1 mm wide; floral rachises, pedicels and perianth (especially at base) with waxy globules or irregular glandular excrescences in the indumentum;

principal flower colour orange-red; floral rachis with rusty striations; perianth indumentum creamy-fawn; perianth limb rusty; style with few to many, minute glandular hairs. The branchlet, perianth and floral rachis indumentum is predominantly creamy fawn with glandular hairs intermixed in *Grevillea tetragonoloba cf.* bright, snow-white and exclusively biramous in *Grevillea nivea.*

The large number of morphological discontinuities evident from the summaries above suggest that *Grevillea nivea* is best recognised at specific rank, rather than as a subspecies of *Grevillea tetragonoloba,* notwithstanding its previous inclusion in that species as a race. Although greyish-leaved specimens of *Grevillea tetragonoloba* show some approach to *Grevillea nivea,* there are no morphological intermediates between the species, both of which otherwise have relatively uniform morphology and occur in self-reproducing, stable populations. Grey-leaved specimens of *Grevillea tetragonoloba* in the east of that species' range are unlikely to represent a separate subspecific taxon, though more collections and field work to examine its morphology, its distribution and population basis are needed. Specimens representative of this foliar variant in every other respect fall within the morphological boundaries of *Grevillea tetragonoloba*, especially in the presence of glandular hairs on branchlets, leaves and conflorescences, waxy globules on the floral rachis and floral indumentum and in the smaller number of longer and narrower leaf lobes. These white, waxy globules, presumably a glandular exudate, represent an autapomorphic character state, not only in relation to *Grevillea tetragonoloba sensu* McGillivray or even the wider group of related species (Group 35 *sensu* Olde & Marriott) but also to the whole genus *Grevillea*, so far as we are aware. Absence of glandular hairs and their waxy globular exudate from the floral indumentum is therefore seen as significant in the recognition of *Grevillea nivea.* Glandular exudates are usually resinous, even in the most closely related species.

Grevillea nivea is an allopatric, geographic isolate, disjunct from *Grevillea tetragonoloba* in both distance and habitat. Population size requires assessment but at least 100 plants were seen by us at Hood Point. In distance, the taxa grow within 50 km of each other but *Grevillea nivea* is found in more exposed, subcoastal situations whereas *Grevillea tetragonoloba* occurs further inland along drainage lines and close to fresh-water river systems between the Pallinup River and West River. Both species are granite-loving and prefer to grow in granite-derived sand.

Horticultural note. Roach (2005) alludes to the outstanding horticultural potential of *Grevillea nivea* and suggests methods of cultivation. It is sold often as *Grevillea* 'Scarlet King'.

Key to related species

The following key involves a slight amendment to the *Key to Species for Group 35* (Olde & Marriott 1994d: 217–218), by insertion of an additional couplet.

25 Leaf lobes flexuose, terete in cross-section; style pinkish-maroon ..... **G. wittweri**

25* Leaf lobes straight, quadrangular in cross-section; style red or orange-red

26 Perianth limb silky to silky-tomentose; widest conflorescence buds 2 mm wide, cylindrical; fruits with glandular hairs absent or very occasional

27 Glandular hairs present on branchlets, leaves and conflorescences; floral rachis, pedicels and perianths with many waxy deposits; leaf lobes 5–8, 4.5–5.8 cm long, 0.8–1.1 mm wide, the margin tightly abutting the midvein on the abaxial surface ..... **G. tetragonoloba**

27* Glandular hairs absent from branchlets. leaves and conflorescences; floral rachis lacking ferruginous striations; floral rachises, pedicels and perianths lacking waxy deposits; leaf lobes 9–15, 1.5–4.5 cm long, 1.1–1.5 mm wide, the abaxial surface exposed beside the midvein in two sulcae *c.* 0.15 mm wide..... **G. nivea**

26* Perianth limb villous; widest conflorescence buds 4 mm wide, ovoid; fruits with few to numerous glandular hairs

27a Floral rachis with white hairs; torus > 1 mm across; widest leaf lobes ≥ 1.3 mm wide; fruit with scattered glandular hairs; branchlets not yellow; leaves not fastigiate..... **G. rigida**

27a* Floral rachis rusty; torus *c.* 0.8 mm across; widest leaf lobes ≤1.2 mm wide; fruit with glandular hairs predominant; branchlets yellow; leaves fastigiate..... **G. fastigiata**

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A new subspecies of *Acacia pentadenia* (Leguminosae: Mimosoideae) from south-western Australia

Jordan E. Reid[1,3], Grant Wardell-Johnson[2] and Bruce R. Maslin[1]

[1]Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
[2]Centre for Ecosystem Diversity and Dynamics, Department of Environmental and Aquatic Sciences,
Curtin University of Technology, GPO Box U1987, Perth Western Australia 6845
[3]Corresponding author

Abstract

Reid, J.E., Wardell-Johnson, G. & Maslin, B.R. A new subspecies of *Acacia pentadenia (Leguminosae: Mimosoideae)* from south-western Australia. *Nuytsia* 19(2): 245–252 (2009). A previously recognised informal variant of *Acacia pentadenia* Lindl. is described following extensive field and herbarium studies focused on the forest region to the north-east of Walpole. The new subspecies, *Acacia pentadenia* subsp. *syntoma*, is most readily distinguished from subsp. *pentadenia* by a combination of morphological attributes, as well as habit, phenological and ecological differences. Field observations have shown the two subspecies to be occasionally sympatric. A key to the subspecies is provided together with a distribution map and comparative images.

Introduction

A low-growing variant of *A. pentadenia* with reflexed leaflets was noted by Maslin in his 1975 revision of *Acacia* series *Pulchellae* and in his 2001 *Flora of Australia* treatment of this group. Subsequent field studies in the Walpole-Denmark area by the second author (Wardell-Johnson) have shown this variant to be distinctive in the field and to have a restricted distribution to the north, east and north-east of Walpole, between the Deep and Kent Rivers. It is a small shrub (to *c.* 1.5 m tall) which grows in pale or yellow, gravelly duplex soils on low rises and in hilly terrain, and flowers from mid-August to late October. While typical *A. pentadenia* also occurs in the same region, and occasionally coexists with the variant, it is a taller plant that usually grows in brown, gravelly duplex soils and commences flowering 1–2 months later than the variant. The observed field differences between the two taxa prompted detailed sampling in 2008 of the region to the north-east of Walpole. Specimens from all known populations of the variant and selected populations of typical *A. pentadenia* were collected and, together with the existing collections at the Western Australian Herbarium, form the basis of the present study. The variant is clearly referable to *A. pentadenia* and although there is no single morphological attribute that characterises it, a combination of vegetative and floral characters normally enable the two taxa to be reliably distinguished. Despite the fact that a few specimens could not be confidently assigned, the variant was assessed to warrant formal recognition and is described below as a new subspecies of *A. pentadenia*.

Taxonomy

Acacia pentadenia Lindley, *Edwards' Bot. Reg.* 18: t. 1521 (1832)

Type citation: 'Collected for Mr. Knight, on the south-west coast of New Holland. It is a very elegant greenhouse plant, flowering in April;'. *Type*: New Holland [Australia], *W. Baxter s.n.* (*lecto*: CGE, *fide* B.R. Maslin, *Nuytsia* 1: 444 (1975).

Acacia pentadenia Lindl. subsp. **pentadenia**

?*Acacia neilii* Hort. ex Seem., *Verh. K.K. Gartenbauges Wien* 1846: 72 (1846). *Type citation*: No type cited. *Type*: *n.v.* Synonymy following K. Koch, *Berliner Allg. Gartenzeitung* 26: 195 (1858).

Acacia biglandulosa Meisn., in J.G.C. Lehmann, *Pl. Preiss.* 2: 205 (1848). *Type citation*: 'Swan River, Drummond. Coll. II. No. 97.' *Type*: Ad. Fluv. Cygnorum [Swan River, Western Australia] *Drummond* [2:] 97 (*holo*: BM (sheet labelled 'HERB. R.J. SHUTTLEWORTH.-Recd. 1877.'), *fide* B.R. Maslin & R.S. Cowan, *Nuytsia* 9: 403 (1994); *iso*: K, MEL, NSW, OXF, P, PERTH 00742090) (NB. Drummond's collection no. either absent or given incorrectly as collection 3 on isotypes).

Acacia pentadenia subsp. **syntoma** J.E.Reid, Wardell-Johnson & Maslin, *subsp. nov.*

Ab *Acacia pentadenia* subsp. *pentadenia* fruticibus 0.5–1.5 m altis, pinnis 2–3 parium, foliolis 1–2.5(4) mm longis, pedunculis 3–7(–8) mm longis, capitulis 1–4 per axillum folii statim dignoscenda.

Typus. Corner of Middle Road and Boronia Road, north side, *c.* 12 km north of Bow Bridge, between Nornalup and Denmark, Western Australia, 11 September 2008, *M. Sowry & K. Bain* MS 116 (*holo*: PERTH 07987749; *iso*: CANB, K, MEL, NY).

Shrubs 0.5–1.5 m tall. *Branchlets* ribbed, glabrous or occasionally sub-glabrous with very sparse, short, straight, patent to antrorse hairs. *Stipules* sometimes ±persistent, linear to linear-triangular, 2–4 mm long, sub-indurate, not pungent. *Pinnae* 2–3 pairs, 3–12 mm long (lowermost pinnae) otherwise 25–85 mm long; *petiole* 1–2(–5) mm long; *rachis* 7–30 mm long, prominently ribbed on upper surface; *leaflets* 1–3 pairs (lowermost pinnae) otherwise 12–30(–36) pairs, obliquely oblong to oblong-elliptic or sometimes approaching triangular, flat or shallowly concave, the margins and apex often slightly recurved (sometimes to such an extent that the leaflets clasp the pinna rachis), sessile, truncate at base, 1–2.5(–4) mm long, 1–2.5 mm wide, green, normally glabrous. *Glands* absent from petiole, present on upper margin of rachis 0–6 mm below insertion of each pair of pinnae, rather prominent, often on a short triangular spur, sessile, circular with a thickened rim and distinct pore. *Inflorescences* 1- or 2-headed rudimentary racemes, 1–2(–3) per axil, totalling 1–4 heads per leaf axil; *raceme axis* 0.5–1.5 mm long; *peduncles* 3–7(–8) mm long, glabrous or occasionally sub-glabrous as on branchlets; *heads* globular, pale or bright yellow, 20–25 flowered. *Flowers* 5-merous; *sepals* united to near their apices, calyx tube often dark-coloured at apex. *Pods* linear, 30–60 mm long, 2–4 mm wide, glabrous, dark-coloured with thickened yellowish margins. *Seeds* longitudinal in the pods.

Selected specimens examined. WESTERN AUSTRALIA: Middle Road, 400 m N of Kangaroo Road, 22 km NE of Walpole, 13 Aug. 1990, *A.R. Annels* ARA 1158 (PERTH); Granite Peaks camp site, off Mitchell Road, 22 Sept. 1994, *T.D. Macfarlane & A.R. Annels* ARA 4465 (PERTH); Granite Peak, N of Walpole, 29 Sept. 1994, *T.D. Macfarlane, A.R. Annels & R. Hearn* TDM 2234-2 (PERTH); Caldyanup Road, 1.1 km W of the Frankland River crossing, 2 Nov. 1994, *T.D. Macfarlane* TDM 2294 (PERTH); 3.6 km W of Nicol Road/Thomson Road intersection, 40 m N of Nicol Road, 12 Feb. 1997, *C. McChesney & C. Day* W 16.1 (PERTH); 3.7 km N of corner of Break Road and Nornalup Road, along Nornalup Road, 20 Aug. 2008, *G. Wardell-Johnson* 16/08 (PERTH); corner of Boronia Road and Middle Road, Kent River, 20 Aug. 2008, *G. Wardell-Johnson* 25/08 (PERTH); *c.* 20 km N of Bow Bridge, 2 km N of corner of Mountain Road and Boronia Road, 23 Oct. 2008, *G. Wardell-Johnson* 305/08 (PERTH).

Distribution. Subspecies *syntoma* has a restricted distribution to the north, east and north-east of Walpole in south-west Western Australia. Its geographic range (approximately 300 km^2) is bounded by the Deep River in the west, the Kent River in the east, the latitude of Mt Roe in the north, and the South Coast Highway in the south (Figure 1). *Acacia pentadenia* subsp. *pentadenia* occurs in the same area but extends beyond the distribution of subsp. *syntoma* in all directions.

Habitat. Subspecies *syntoma* is restricted to sandy/gravelly pale-coloured or yellow duplex soils on low rises, hills and ridges with granitic or sedimentary substrates (Figure 2B, Table 1). This subspecies generally occurs in the 900–1100 mm rainfall zone and is largely restricted to jarrah (*Eucalyptus marginata*)/marri (*Corymbia calophylla*) open forest and woodland. Associated species include *Banksia grandis*, *Hakea florida*, *H. amplexicaulis*, *Taxandria hypericifolia*, *T. parviceps*, *Kingia australis*, *Persoonia longifolia*, *Bossiaea ornata*, *B. linophylla*, *Podocarpus drouynianus* and *Crowea angustifolia*.

Subspecies *pentadenia* (Figure 2A) predominates on hilly terrain on brown gravelly duplex soils over granite or on yellow duplex soils in higher rainfall areas (over 1100 mm). It occurs predominantly in tall forest dominated by karri (*Eucalyptus diversicolor*), red tingle (*E. jacksonii*) and yellow tingle (*E. guilfoylei*), but also occurs on the margins of these forest types where marri dominates. Associated species in these areas include *Leucopogon australis*, *Lepidosperma effusum*, *Hibbertia cuneiformis*, *Pteridium esculentum*, *Acacia urophylla*, *Agonis flexuosa*, *Chorilaena quercifolia* and *Boronia gracilipes*.

The small area north-east of Walpole where the two subspecies occur is climatically, edaphically and topographically complex. In some places, particularly in areas featuring steep environmental gradients, there are sympatric occurrences of the two subspecies. These include a site at Granite Peak, approximately 25 km north of Walpole, the corner of Western and Mitchell Roads, approximately 27 km north-east of Walpole, and Thompson Road between Nicol and Beardmore Roads, approximately 19 km north of Walpole. These areas have steep ecological boundaries with slope and soil type changing rapidly (T.D. Macfarlane, pers. comm.). No confirmed hybrids between the two subspecies have been observed or collected at these localities, and all vouchered specimens have been confidently assigned.

Flowering and fruiting period. Subspecies *syntoma* commences flowering in mid August and ends in late October. Immature pods have been collected in late October. Mature seed is present on the plants between December and January and is shed by February. Recent field observations in the area north-east of Walpole show that in any one year subsp. *pentadenia* commences flowering 1–2 months later than subsp. *syntoma*.

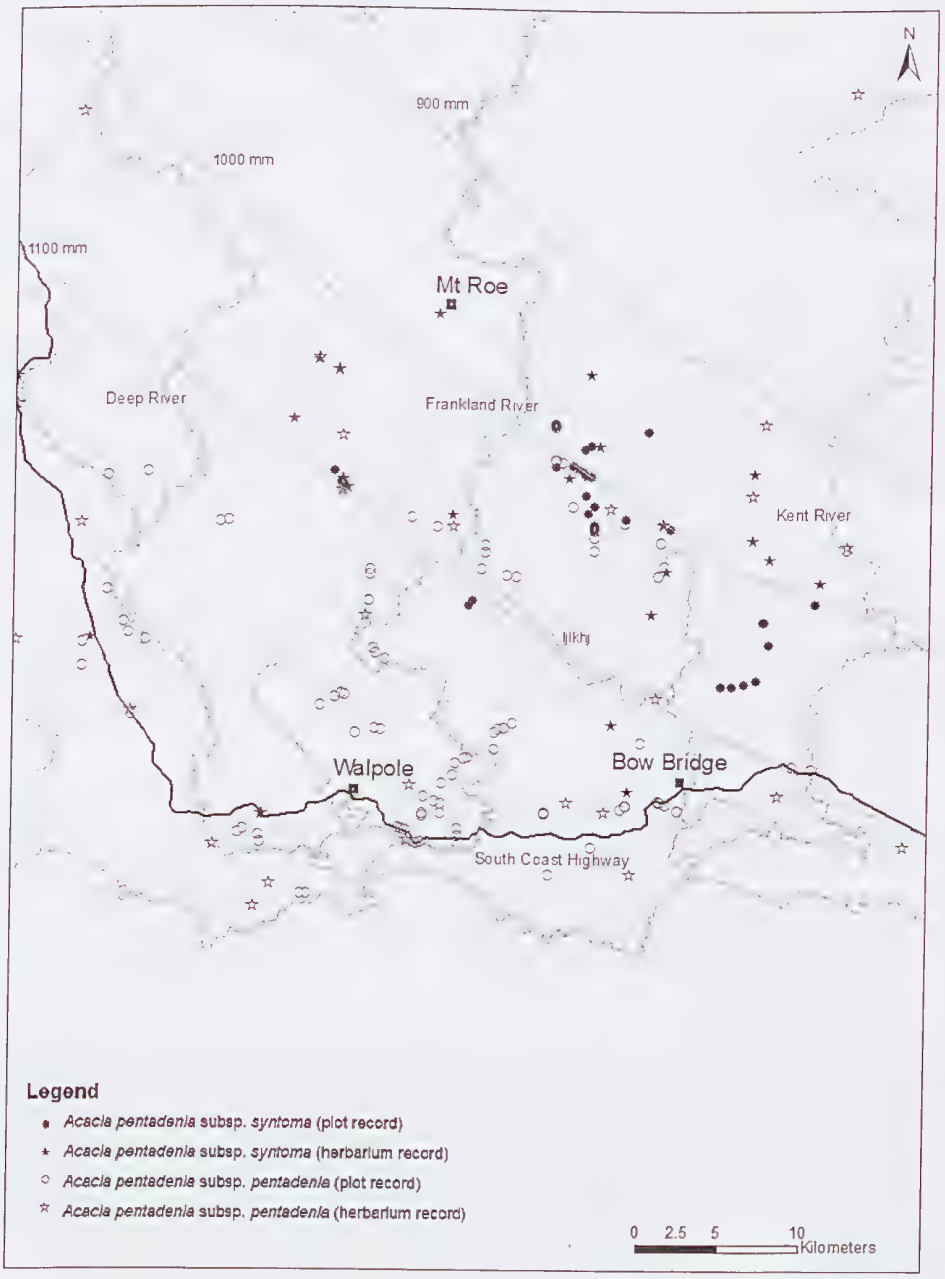

Figure 1. Distribution of *Acacia pentadenia* subsp. *syntoma* and subsp. *pentadenia* (within the study area) in south-west Western Australia. Occurrences of the two subspecies are taken from herbarium records and plot records from the Tingle Mosaic floristic survey (Wardell-Johnson & Williams 2006). A total of 29 quadrats from 283 quadrats located within the study area included subsp. syntoma. Subspecies *pentadenia* extends in distribution beyond subsp. *syntoma* in all directions outside the mapped area.

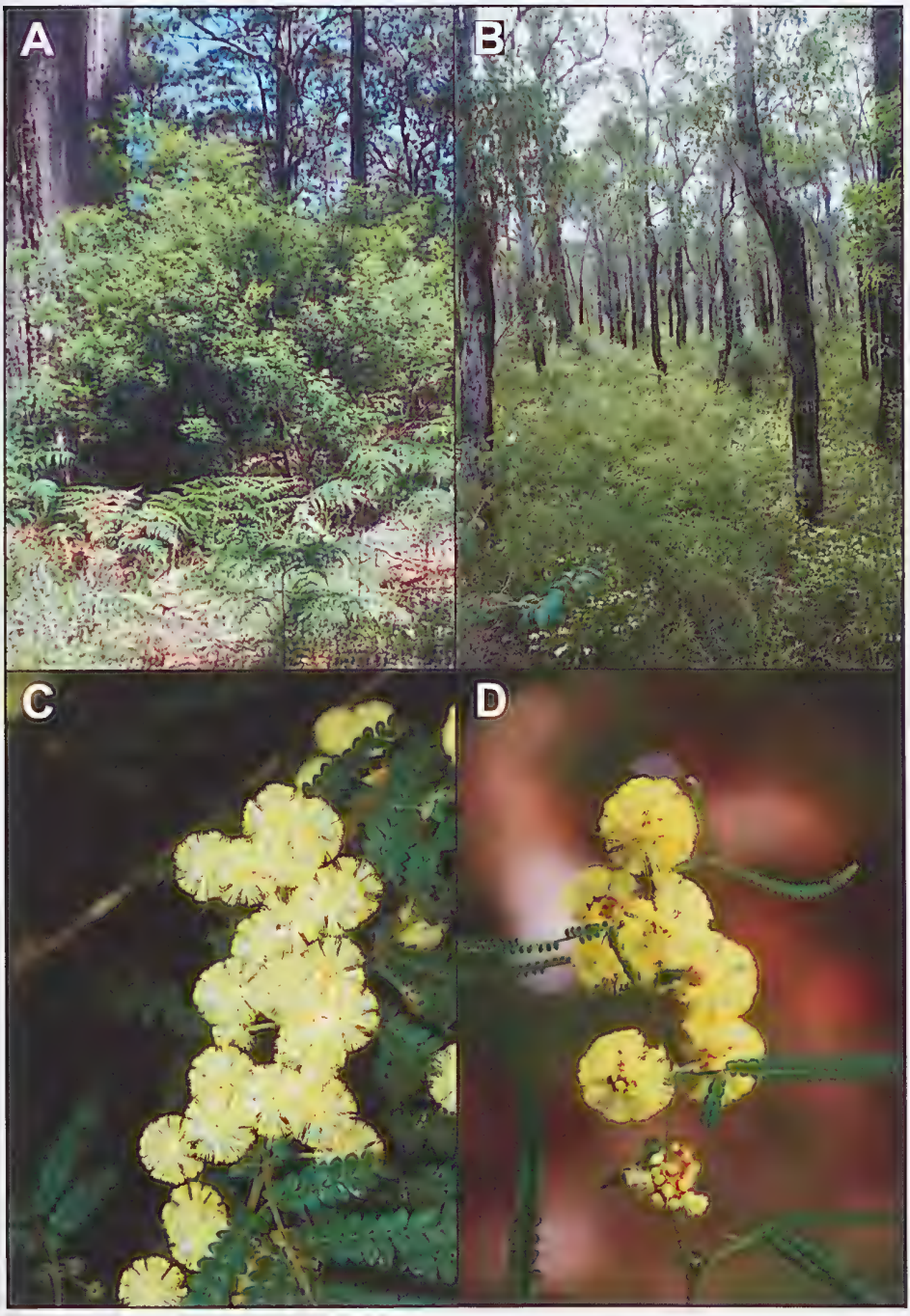

Figure 2. Comparative images of *Acacia pentadenia* subsp. *pentadenia* (A & C) and subsp. *syntoma* (B & D). A – habit and habitat of subsp. *pentadenia* in karri forest; B – habit and habitat of subsp. *syntoma* showing over storey dominance of jarrah/marri open-forest; C – inflorescences and foliage of subsp. *pentadenia*, D – inflorescences and foliage of subsp. *syntoma*. Photographs by B.R. Maslin (A), G. Wardell-Johnson (B & D), and E. McCrum (C).

Table 1. Frequency of occurrence of *Acacia pentadenia* subsp. *syntoma* and subsp. *pentadenia* in quadrats in the floristic survey of the Tingle Mosaic (Wardell-Johnson & Williams 1996) in relation to the soils and landform/soils units of Churchward et al. (1988). The survey included 441 quadrats in an area from Deep River to Two Peoples Bay and inland to Roe Road. A total of 283 quadrats were located in the study area shown in Figure 1.

Habitat		**Taxa**	
Soils description	**Topography (landform/soils units)**	***A. pentadenia* subsp. *pentadenia* (quadrats)**	***A. pentadenia* subsp. *syntoma* (quadrats)**
Brown gravelly duplex (b) soils on granitic terrain	Hills and ridges > 60 m relief (Keystone)	92 (104)	2 (104)
	Hills and hilly terrain (20–60 m relief – Mattaband) and Low hills and hilly terrain (Collis)	8 (10)	0 (10)
	Major valleys	9 (9)	0 (9)
Gravelly yellow duplex (y) soils on granitic terrain	Hills and ridges > 60 m relief (Keystone)	16 (43)	7 (43)
	Hills and hilly terrain (20–60 m relief – Mattaband) and Low hills and hilly terrain (Collis)	8 (20)	4 (20)
	Margins of swampy areas (Angove, Burnett, Caldyanup, Owingup, Quagering)	8 (50)	1 (50)
Shallow, gritty yellow duplex soils (p), margins of granitic outcrop (g) and podzols (s)	Hills and ridges > 60 m relief (Keystone)	8 (26)	6 (26)
Sands and laterite on crests or sandy gravelly yellow duplex soils on siltstones and sandstones	Ridge crests and undulating sandy terrain (Dempster, Trent, Fernley)	0 (18)	9 (18)

Conservation status. Not considered rare or endangered.

Rank. In applying rank to this new entity we have adopted the criteria of Cowan and Maslin (1995). Therefore, judging from morphological, phenological and ecological evidence it is deemed appropriate to treat this entity as a subspecies of *A. pentadenia.*

Common name. False Karri Wattle.

Etymology. The subspecies name is derived from the Greek *syntomos* (abridged, shortened) and refers to the low statue and short leaflets which help distinguish the new subspecies from subsp. *pentadenia.*

Table 2. Main differences distinguishing *Acacia pentadenia* subsp. *pentadenia* from subsp. *syntoma*

Attribute	subsp. *pentadenia*	subsp. *syntoma*
Habit	Shrub or tree, 2–5(–9) m tall.	Shrub, 0.5–1.5 m tall
Rachis length (mm)	10–50	7–30
Pinnae (pairs)	2–5 (6–8)	2–3
Leaflets		
Length (mm)	2.5–6	1–2.5(–4)
Posture	Flat, but margins and/or apex sometimes slightly recurved.	Flat or shallowly concave; margins and apex often slightly recurved.
Heads		
Number per raceme	(1–)2–4	1–2
Total number per axil	(3–)4–9	1–4
Peduncle length (mm)	8–20	3–7(–8)
Habitat	Brown, gravelly duplex soils on hilly terrain over granite or on yellow duplex soils in high rainfall areas of the region.	Yellow, sandy/gravelly duplex soils on low rises, hills and ridges with granitic or sedimentary substrates.
	Mostly occurring in tall forest dominated by karri, red tingle and yellow tingle.	Largely restricted to jarrah/marri open forest and woodland.
Flowering time	September – November	August – October

Affinities. Subspecies *pentadenia* (Figure 2C) differs most obviously from subspecies *syntoma* (Figure 2D) by its generally more numerous pairs of pinnae (2–5), longer leaflets (2.5–6 mm long), longer peduncles (8–20 mm long) and greater number of heads per leaf axil (occasionally 3, but usually 4–9). There is no single morphological attribute that uniquely separates subsp. *syntoma* from subsp. *pentadenia* as shown in Table 2, however, when used in combination the above attributes enable the two taxa to be generally reliably distinguished (see **Key to subspecies**). Furthermore, in the field the two subspecies can be distinguished by their stature (taller in subsp. *pentadenia*), phenology (see above) and importantly they are separated ecologically as discussed under *Habitat* above and shown in Table 1. Notwithstanding the above differences there are a few specimens that can not be confidently assigned to one subspecies or the other.

For comparative purposes the description of *A. pentadenia* provided by Maslin (2001) applies to subsp. *pentadenia*.

Key to subspecies

Peduncles 3–8 mm long; heads 1–4 per leaf axil; leaflets 1–2.5(–4) mm long; pinnae 2–3 pairs. Shrubs 0.5–1.5 m tall ..... subsp. **syntoma**

Peduncles more that 8 mm long or if shorter then other characters not combined as above (i.e. heads more numerous or leaflets longer or pinnae more numerous). Shrubs or trees 2–5(–9) m tall ..... subsp. **pentadenia**

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A new species of *Hakea* (Proteaceae) from the Swan Coastal Plain, Western Australia

Kelly A. Shepherd[1] and Robyn M. Barker[2]

[1]Western Australian Herbarium, Department of Environment and Conservation, Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
[2]State Herbarium of South Australia, Department for Environment and Heritage, PO Box 2732, Kent Town, South Australia 5071
[1]Corresponding author. Email: Kelly.Shepherd@dec.wa.gov.au

Abstract

Shepherd, K.A. & Barker, R.M. A new species of *Hakea* (Proteaceae) from the Swan Coastal Plain, Western Australia. *Nuytsia* 19(2): 253–258 (2009). *Hakea oligoneura* K.A.Sheph. & R.M.Barker, a new species described herein, is only known from a few populations less than 100 km from the Perth metropolitan area. A distribution map and images of this new species are included.

Introduction

Hakea Schrad. & J.C.Wendl. is one of the largest endemic genera in Australia with around 150 species currently recognised. Even though this genus was revised a decade ago for the *Flora of Australia* (Barker *et al.* 1999), new species are still being discovered and described, some of which occur in close proximity to urban regions. One such example is the recently described *Hakea chromatropa* A.S.George & R.M.Barker (George & Barker 2007), which occurs less than 150 km from the Perth metropolitan area in Western Australia. It was only recognised as being distinct from *H. ilicifolia* R.Br. when flowering specimens were obtained for the first time in 2006.

This recent discovery highlights the value of ongoing botanical survey effort even in relatively densely populated areas such as the Swan Coastal Plain. Another poorly known taxon, found on coastal limestone in the Yalgorup National Park less than 100 km south of the Perth, is described here. This taxon was initially informally named '*Hakea undulata* limestone variant (B. Keighery & N. Gibson 237)' and was later given the phrase name *Hakea* sp. Yalgorup (B.J. Keighery & N. Gibson 897). As it was only known from a few populations in a National Park it was given a Priority Four Conservation Status by the Department of Environment and Conservation. Despite this taxon being recognised as potentially new for more than 10 years, a lack of adequate material hindered the clarification of its status. Further collections by K.A. Shepherd and N. Gibson were made in September 2008 and it is apparent that while this taxon is allied to *H. anadenia* Haegi and *H. undulata* R.Br. it is readily distinguished by a number of vegetative and floral characters.

Methods

Characters were measured from specimens lodged at the Western Australian Herbarium (PERTH). Floral measurements were made using spirit material preserved in 70% ethanol and herbarium sheet material rehydrated in hot water with a small amount of detergent. Terminology for characters follows that of Barker *et al.* (1999) with the exception of the perianth measurements, which were made on open flowers rather than mature buds. This species has a Department of Environment and Conservation Priority listing. Accordingly, exact localities of known populations have been withheld. The distribution map was created using DIVA-GIS Version 5.2.0.2 and show IBRA Version 6.1 regions (Department of the Environment, Water, Heritage and the Arts 2008).

Revised *Flora of Australia* key to species of *Hakea* (Barker *et al.* 1999: 31–170)

For *Hakea oligoneura,* the *Undulata* Group should be amended at Couplet 1 (p. 125) as follows:

1 Leaf margin spinulose-dentate, some leaves rarely entire

1a Leaves without visible secondary venation, with (0–)1–5 mucros per margin; fruit 1.1–1.8 cm long, 0.55–1.15 cm wide (Yalgorup National Park, W.A.; flowers August–September) ..... **H. oligoneura**

1a: Leaves with with prominent secondary venation, (2–)5–10 mucros per margin, fruit 1.7–3 cm long, 0.8–1.4 cm wide

2 Erect shrub; leaves 20–65 mm wide, longitudinal veins 3–7; flowers cream-white; pistil 3–4 mm long; fruit 2.3–3 cm long, 1–1.4 cm wide, often more than 3 per axil (Darling Range to Albany, W.A.; flowers July–October) ..... **H. undulata**

2: Bushy shrub; leaves 6–20 mm wide, longitudinal veins 1–3; flowers white to pink; pistil 4–6 mm long; fruit 1.7–2.3 cm long, 0.8–1.1 cm wide, never more than 3 per axil (Eneabba to Moore River area and Pingelly/Narrogin area, W.A.; flowers July–October) ..... **H. anadenia**

Taxonomy

Hakea oligoneura K.A.Sheph. & R.M.Barker *sp. nov.*

Ab *Hakea anadenia* Haegi and *Hakea undulata* R.Br. marginibus foliorum leniter undulatis, mucronibus paucis sine nervis secundariis, et pistillo breviore statim diagnoscenda.

Typus: Yalgorup National Park, Western Australia [precise locality withheld for conservation purposes], 17 September 2008, *K.A. Shepherd & N. Gibson* KS 1124 (*holo*: PERTH 07909225; *iso*: AD, CANB).

Hakea sp. Yalgorup (B.J. Keighery & N. Gibson 897), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed 1 May 2009].

Hakea undulata limestone variant (B. Keighery & N. Gibson 237), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed 1 May 2009].

Shrubs 1.8–2 m high and up to 2 m wide. *Bark* smooth or finely fissured. *Branchlets* terete with dense, adpressed, ferruginous or white, simple hairs 0.2–0.4 mm long, glabrescent. *Leaves* alternate, narrowly elliptic to oblanceolate, flat or rarely shallowly concave, 21–68 mm long, 4.5–10 mm wide, narrowly attenuate towards the base, spinose-dentate, with (0–)1–5 mucros per margin, margin straight or shallowly curved between each mucro, rarely entire, apex acute, mucro 0.1–0.5 mm long, glabrous or with infrequent, adpressed hairs 0.1–0.4 mm long; longitudinal veins 1–3(4), prominent above and below, secondary venation obscure. *Inflorescence* axillary, almost sessile; rachis 1–2 mm long, with dense, stiff, white hairs 0.3–0.5 mm long. *Bracts* ovate, strongly concave, 0.5–2.4 mm long, 0.6–1.6 mm wide, with adpressed white hairs 0.1–0.2 mm long, caducous. *Flowers* 6–14. Pedicel 1.2–2.4 mm long, glabrous. *Perianth* 2.5–3.5 mm long, glabrous, white; limb recurved in bud, broadly elliptic, 0.7–1.1 mm long, 0.4–1.1 mm wide; tepals 4 splitting to base after anthesis; anthers 0.4–0.5 mm long, 0.2–0.3 mm wide. *Torus* oblique; gland vestigial, globular, 0.2–0.3 mm long or absent. *Pistil* 2.8–3.6 mm long; pollen presenter conical, 0.4–0.6 mm long; pollen yellow; ovary stipe 0.3–0.6 mm long. *Fruit* almost sessile, down-curved, broadly ovoid, 11–18 mm long, 5.5–11.5 mm wide, beaked, pustulate and ridged, splitting almost to the base. *Seed* along upper side of follicle, obliquely ovate, 8–12 mm long, 4–5 mm wide, black; seed body 2.6–4.4 mm long, 2–2.8 mm wide; wing extending fully or almost fully down both sides of the seed, wider on the upper edge. (Figure 1)

Other specimens examined. WESTERN AUSTRALIA: 22 Dec. 2008, *B. Fellows & J. Waud* BCF 56 (PERTH 08008523); 20 Sep. 2003, *P. Foreman* 379 (PERTH 06781276); 20 June 2002, *P. Foreman & J. Kelly* TT 125 (PERTH 06388140); 19 Sep. 1993, *B.J. Keighery & N. Gibson* 896 (PERTH 04305655); 19 Sep. 1993, *B.J. Keighery & N. Gibson* 897 (PERTH 04305639); 19 Sep. 1993, *B.J. Keighery & N. Gibson* 907 (PERTH 04305647); 25 Aug. 1993, *G.J. Keighery* 14992 (PERTH 05041309); 6 Mar. 1994, *G.S. McCutcheon* GSM 2869 (PERTH 06402887); 20 Oct. 1972, *S. Paust* 1422 (PERTH 05496489); 17 Sep. 2008, *K.A. Shepherd & N. Gibson* KS 1125 (PERTH 07909233).

Distribution and habitat. Currently only known from a few isolated populations in Yalgorup National Park and Tim's Thicket Reserve. This park is located along the coast between Mandurah and Bunbury in the Swan Coastal Plain (SWA) IBRA region (Department of the Environment and Water Resources 2007) (Figure 2). This species is found growing in white-brown sand on limestone ridges in open Mallee (*Eucalyptus decipiens* and *E. patrensis*) over *Melaleuca acerosa*, *Xanthorrhoea* and *Hibbertia*.

Phenology. Flowering specimens have been collected in August and September with fruits forming by late October.

Conservation status. As *Hakea oligoneura* is known from a few populations, it currently has a Priority Four – Rare Taxa conservation status under the Conservation Codes for Western Australian Flora (Atkins 2008). This indicates that this species is considered to be rare but not currently under threat from extinction.

Etymology. From the Greek *oligo* (few) and *neuron* (nerve) in reference to the lack of obvious secondary venation of the leaves, a feature that distinguishes this species from its closest relatives.

Affinities. Hakea oligoneura is included in the *Undulata* group (Barker *et al.* 1999) and appears most closely allied to *H. anadenia*. It is readily distinguished from *H. anadenia* by its leaves, which have only (0–)1–5 mucros per margin and the margin is almost straight or only very shallowly curved between each mucro. Furthermore, the leaves have 1–3 longitudinal veins with no obvious secondary venation. *H. oligoneura* also has smaller flowers and a tendency towards smaller fruits (Figure 1). In contrast,

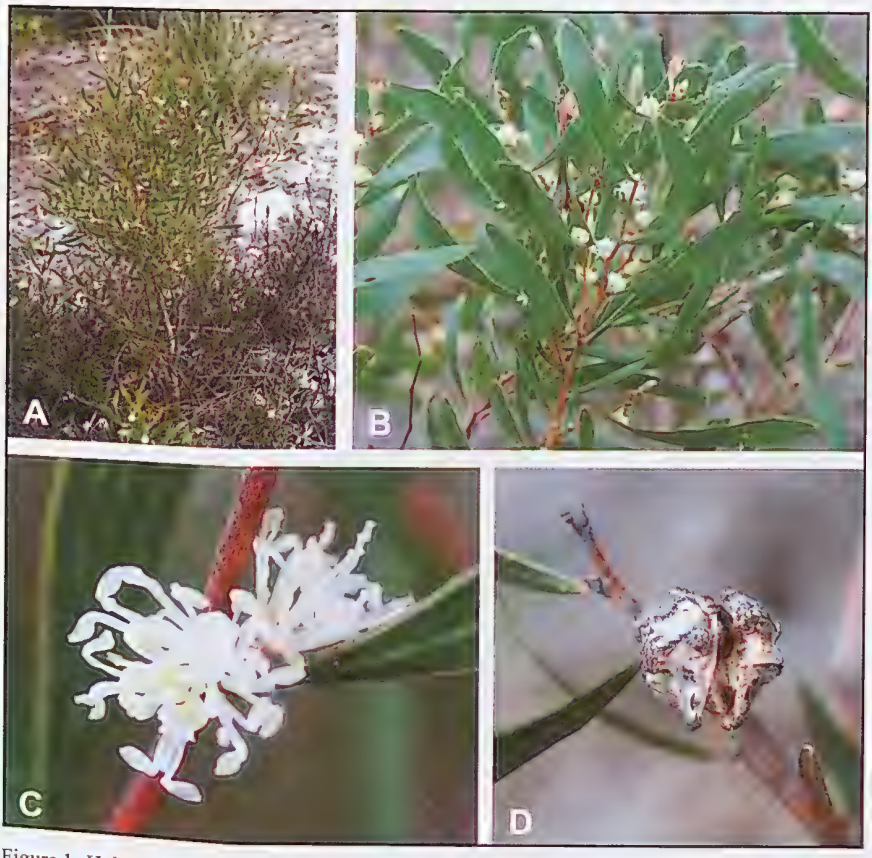

Figure 1. *Hakea oligoneura* (*K.A. Shepherd & N. Gibson* KS 1124). A – habit; B – flowers and leaves showing the typical longitudinal veins and absence of obvious secondary venation; C – flowers; D – fruit. Photographs by K.A. Shepherd.

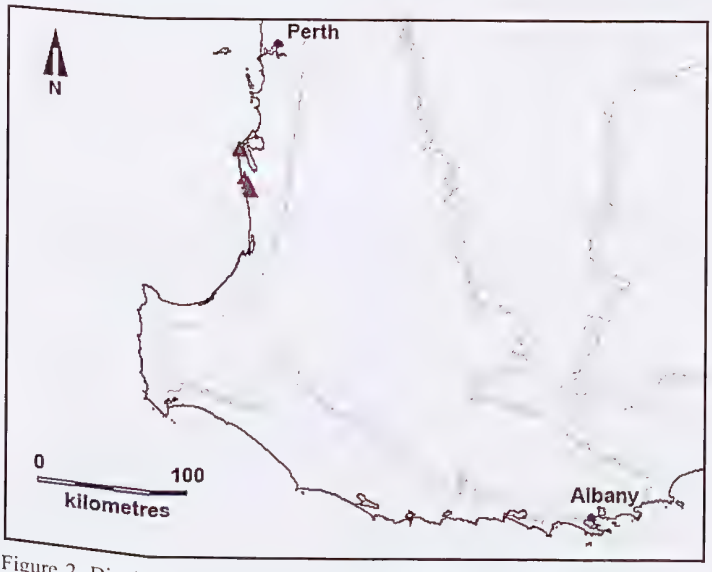

Figure 2. Distribution of *Hakea oligoneura* in the Yalgorup National Park on the Swan Coastal Plain, Western Australia. Version 6.1 IBRA regions shown in grey.

H. anadenia has leaves with prominent secondary venation and (2–)5–10 mucros per margin and the margin is more strongly curved between each mucro (Figure 3C). Another related species *H. undulata* (Barker *et al.* 1999), has similar leaves to *H. anadenia* in terms of the mucro number and the obvious secondary venation (although being much broader) and is therefore also easily recognised as distinct from *H. oligoneura* (Figure 3 A, B).

Hakea oligoneura is only found on coastal limestone ridges south of Perth, whereas *H. anadenia* occurs on sandy soil from Eneabba to Moore River to the north and inland around Pingelly to Narrogin. Similarly, *H. undulata* occurs on sandy to gravelly soil or clay over granite or laterite from the Darling Range east of Perth to Albany on the south coast.

Notes. Two collections (PERTH 06388140 and PERTH 06402887) from Tim's Thicket Reserve north of the type locality of *Hakea oligoneura* have only mature fruits present. The fruits are typical of

Figure 3. *Hakea undulata* (*K.A. Shepherd & N. Gibson* KS 1112). A – habit showing leaves with obvious secondary venation; B – flowers; *H. anadenia* (*J.A. Wege* 1528). C – leaves and old flowers. Photographs by K.A. Shepherd (A, B) and J.A. Wege (C).

H. oligoneura but the leaves are slightly thicker, yellow-greenish with fewer obvious mucros on the margin andsome of the leaves are entire. These plants were collected from a steep limestone hillside that is typical of *H. oligoneura*.

Acknowledgements

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Thysanotus unicupensis (Laxmanniaceae), a new species discovered in Unicup Nature Reserve, south-west Western Australia

Udani M. Sirisena[1], Terry D. Macfarlane[2] and John G. Conran[1]

[1]Centre for Evolutionary Biology and Biodiversity, Discipline of Ecology and Evolutionary Biology, School of Earth and Environmental Sciences, DX 650312, The University of Adelaide, South Australia 5005
[2]Western Australian Herbarium. Postal address: Science Division, Department of Environment and Conservation, Locked Bag 2, Manjimup, Western Australia 6258

Abstract

Sirisena, U.M., Macfarlane, T.D. and Conran, J.G. *Thysanotus unicupensis* (Laxmanniaceae), a new species discovered in Unicup Nature Reserve, south-west Western Australia. *Nuytsia* 19(2): 259–263 (2009). *Thysanotus unicupensis* is described as a new species from south-west Western Australia. This species shows some affinities to *T. chinensis, T. formosus* and *T. parviflorus* and is apparently localised on lateritic soils in moderately sunny areas within Jarrah/Marri (*Eucalyptus marginata*/*Corymbia calophylla*) woodlands. The key published in *Flora of Australia* (1987) is amended to include the new species.

Introduction

The genus *Thysanotus* R.Br. *nom. cons.* (Asparagales: Laxmanniaceae *sensu* Angiosperm Phylogeny Group 2003) consists of over 50 species, all endemic or native to Australia, with *T. banksii* R.Br. and *T. chinensis* Benth. also in Papua New Guinea and the latter species extending to Malesia, Thailand, China and the Philippines (Jessop 1979, Conran 1998, Chen & Tamura 2000). Before being moved to Laxmanniaceae, the genus was variously placed in Liliaceae (Cronquist 1981), Anthericaceae (Marchant *et al.* 1987) or Lomandraceae (Chase *et al.* 1996; Conran 1998). The majority of the species occur in south-west Western Australia and following the treatments of Baker (1876) and Bentham (1878), Brittan described many new species from Western Australia (Brittan 1960, 1972), South Australia (Brittan 1971a, 1978) and New South Wales (Brittan 1971b) . In his subsequent revision of the genus, Brittan (1981) recognised 47 species and in the later treatment for the *Flora of Australia* (Brittan 1987) this was increased to 49 species, of which 42 are Western Australian. Since then several new *Thysanotus* species have been recognised (Paczkowska & Chapman 2000; Macfarlane pers. comm.), although not yet described formally, and most require further collecting and study to define them more precisely.

While collecting material in Western Australia for a larger phylogenetic study of *Thysanotus* in late spring 2007, we observed and collected specimens of a species in the Unicup Nature Reserve *c.* 50 km east of Manjimup, south-west Western Australia which was not recognisable immediately and which was found subsequently to be morphologically distinct from all other known *Thysanotus* species. Further examination of material both from our collections and from accessions in the Western Australian Herbarium (PERTH) revealed that these specimens represented an unnamed species of *Thysanotus*. Accordingly, we here describe this new species following the descriptive terminology and criteria for species within the genus used by Brittan (1981, 1987).

Description

Thysanotus unicupensis Sirisena, T.Macfarlane & Conran, *sp. nov.*

Herba erectus. Radices fibrosae, non tuberosae. Folia recta, *c.* 30 cm longa, *c.* 2mm lata, glabra, basin versus vaginis membranaceis. Inflorescentia sessile umbellarum (1–5) terminalium. Scapus simplex, 15 cm altus, teres, glaber. Umbellae floribus 2–3, bracteis lanceolateis, 5–6 mm longis, membrenaceis, acuminatis. Pedicelli 7–9 mm longi, prope basin articulati, florescentes erecti, fructiferi erectes. Segmenta perianthii 8–9.5 mm longa: tepala exteriora lanceolata, 1.2–1.5 mm lata, mucronata; tepala interiora latus elliptica, *c.* 3.2–3.5 mm lata, fimbriis *c.* 1.3 mm longis. Stamina 6, antherae strictae, non tortae vel haud tortae, 4 mm longae. Ovarium utroque loculis, ovulis 2. Stylus rectus vel haud curvatus. Capsula perianthio persistenti inclusa, 5 x 3 mm longa. Semina nigra, arillata.

Typus: Unicup Nature Reserve, Western Australia [precise locality withheld for conservation reasons], 28 November 2007, *U.M. Sirisena & T.D. Macfarlane* 13 (*holo*: PERTH).

Perennial *herb c.* 30 cm tall, with small rhizomes and fibrous-fleshy non-tuberous roots 10–12 cm long. *Leaves* green at flowering time, usually up to 5 per plant, basal, terete, glabrous, *c.* 30 cm long, *c.* 2 mm wide, expanding into membranous wings at base, margins entire; leaf bases enclosed by flat, white, oblong membranous bracts. *Scape* half to three quarters of length of leaves, usually unbranched. *Inflorescence* made of umbels aggregated in a terminal cluster which superficially resembles a single umbel, usually 2–4 flowers per umbel, the whole cluster of 7–17 flowers but sometimes with 1 or 2 bracts either empty or subtending sessile or shortly pedunculate secondary umbel cluster; umbel bracts usually 3, ovate to lanceolate, 5–7 (–10.5) mm long, 2–3.5 mm wide, margin broad, membranous, apex acuminate. *Pedicel* 7–9 mm long, articulated towards the base, erect in flower and fruit. *Tepals* 8–9.5 mm long, outer 3 lanceolate, 1.2–1.5 mm wide, mucronate, inner three broadly elliptic-circular, 3.2–3.5 mm wide; fimbriae *c.* 1.3 mm long. *Stamens* 6, filaments *c.* 1.5 mm long; anthers subequal, basifixed, purple, paler towards the tip, straight, slightly twisted or not twisted, dehiscence by a terminal pore; pores *c.* 0.5 mm long, the back lip exceeding the front lip, outer anthers 3.6 mm long, inner anthers 3.8–4 mm long. *Ovary* trilocular with 2 ovules per loculus, style straight to slightly curved. *Capsule* ellipsoid, *c.* 5 by 3 mm, enclosed within persistent perianth segments forming only a short tail. *Seed* black, narrowly ellipsoid, *c.* 1.5 mm long, *c.* 1 mm wide with strongly convex periclinal walls and striated microsculpturing; aril straw coloured and sessile. (Figure 1)

Specimens examined. Unicup Nature Reserve, WESTERN AUSTRALIA: [precise localities withheld for conservation reasons] , 28 Nov. 2007, *U.M. Sirisena & T.D. Macfarlane* 16 (PERTH); 7 Dec. 2007, *T.D. Macfarlane* 4183 *& R.W. Hearn* (PERTH); 20 Oct. 1997, *A.D. Robinson* K 69 (PERTH); Nov. 1997, *A.D. Robinson & B.G. Ward* K 89 (PERTH); 5 Dec. 1991, *G.S. McCutcheon* 2435 (PERTH); 29 Oct. 1998, *R. Davis* 8564 (PERTH).

Distribution and habitat. Known from Unicup Nature Reserve to the Mulallyup and Boyup Brook areas, south-west Western Australia. *Thysanotus unicupensis* grows on dry lateritic and grey sandy soils in moderately sunny places within Jarrah/Marri forests.

At the Unicup Nature Reserve *Thysanotus patersonii* R.Br., *T. multiflorus* R.Br. and *T. thyrsoideus* Baker co-occur with *T. unicupensis*, but show spatial and/or temporal separation. *Thysanotus patersonii* and *T. unicupensis* both grow in moderately sunny places within the Jarrah/Marri woodland, but *T. patersonii* was already fruiting when the latter was flowering. In contrast, *T. multiflorus* and

Figure 1. *Thysanotus unicupensis*. A – habit; B – fleshy roots; C – inflorescence; D – flowers and fruits; E – seed; F – periclinal walls on seed surface. Scale bars: A = 10 cm; B = 5 cm; C–D = 10 mm; E = 500 µm; F = 50 µm. Voucher: Sirisena & Macfarlane 13 (PERTH). Photographs by Udani M. Sirisena.

T. thyrsoideus flowered simultaneously with *T. unicupensis*, but the former two grew on the more exposed, sunny edges of the forest rather than the more sheltered interior.

Phenology. Flowering late October to early December.

Conservation status. Currently listed as Priority Two under the Department of Environment and Conservation (DEC) Conservation Codes for Western Australia. The species has only been collected a few times although over a range of approximately 100 km in an area with extensive forest including conservation reserves. A systematic survey has not yet been carried out although some localised

searches have been conducted, and the various collections were only recognised as belonging together as a single taxon after we saw live plants and understood its distinctness.

Etymology. Named after the Unicup Nature Reserve where we first recognised the species.

Notes. Possession of fleshy roots in *Thysanotus unicupensis* may indicate a relationship to *T. chinensis*, *T. formosus* Brittan and *T. parviflorus* Brittan which also possess fleshy, non-tuberous roots. Although *T. chinensis* was described by Payens (1957), Jessop (1979) and Brittan (1987) as having fibrous roots, examination of live specimens from Queensland and the Northern Territory revealed that it possesses fleshy, non-tuberous roots when alive. These three species share several other morphological features such as an erect habit, glabrous scape and leaves, terete leaves, six stamens and anther dehiscence by a terminal pore. *Thysanotus unicupensis* is most easily distinguished from these other species by having straight to slightly twisted anthers of more or less equal length, sessile umbels clustered towards the scape apex and leaves more or less twice as long as the scape. Out of these three putative relatives, the new species seems closer to *T. formosus* than to either *T. parviflorus* or *T. chinensis*, as it shares with the former features such as a simple scape with sessile umbels and erect pedicels in flower and fruit. In contrast, the scape of *T. parviflorus* is unbranched to 4-branched, bearing pairs of closely appressed umbels at the apex, whereas the buds and fruits of *T. chinensis* are pendant (Brittan 1981).

The inflorescence structure of *T. unicupensis* and *T. formosus* is unusual in the genus where the umbels are usually discrete and easily delimited, despite varying from 1 - 2-flowered to many-flowered. In those two species the umbels are less easily delimited. The whole inflorescence of *T. unicupensis*, when best developed, consists of a terminal aggregation of flowers which looks superficially like a many-flowered umbel, and one or more smaller umbels below, either sessile or on short, obscure branches. Whilst these smaller umbels may be discrete and clearly separated from the terminal flowers, the terminal aggregation on closer examination looks more like a loose collection of several small umbels bearing as few as two flowers. *Thysanotus formosus* likewise has small umbels, usually 2-flowered, that aggregate to resemble superficially a larger umbel.

Amendment to published key to *Thysanotus* species

The key published in *Flora of Australia* (Brittan 1987) is amended to accommodate *Thysanotus unicupensis* by inserting a new couplet 10a within couplet 10. Couplet 10 is reached with plants that have six stamens having equal or subequal anthers, an annual scapose inflorescence that is not paniculate, and flowers usually two or more per umbel.

10 Inflorescence not paniculate, a single terminal umbel or cluster, sometimes with 1 or 2 subterminal umbels sessile or on a short branch

10a Roots tuberous; anthers dehiscing by slits; pedicels of fruit nutant ..... **T. isantherus**

10a: Roots not tuberous; anthers dehiscing by terminal pores; pedicels of fruit erect ..... **T. unicupensis**

10: Inflorescence paniculate

Acknowledgements

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A new circumscription for *Lysinema ciliatum* (Ericaceae: Styphelioideae: Epacrideae) and reinstatement of *L. pentapetalum*

Kevin R. Thiele

Western Australian Herbarium, Department of Environment and Conservation, Locked Bag 104,
Bentley Delivery Centre, Western Australia 6983
Email: kevin.thiele@dec.wa.gov.au

Abstract

Thiele, K.R. A new circumscription for *Lysinema ciliatum* (Ericaceae: Styphelioideae: Epacrideae) and reinstatement of *L. pentapetalum*. *Nuytsia* 19(2): 265–275 (2009). *Lysinema ciliatum* has long been regarded as a widespread and variable species. Occurring throughout much of the South-West Botanical Province of Western Australia on a variety of substrates, it is morphologically variable in foliar and floral characters, with up to eleven morphotypes informally recognised as putatively distinct taxa following a preliminary assessment in the early 1990s. Examination of material from throughout the species' range shows that most of the currently recognised informal morphotypes comprise a single, variable species which cannot be adequately divided into taxa. A second, distinct species is restricted to the south coast of Western Australia, approximately between Albany and Esperance, with a disjunct outlier east of Perth. Comparison with types shows that the correct name for the widespread taxon is *Lysinema pentapetalum* R.Br., while the mostly southern-coastal taxon matches the type of *L. ciliatum*. Descriptions and distribution maps are provided for these taxa, along with a key to all species of *Lysinema*.

Introduction

Lysinema R.Br. was erected by Brown (1810) to accommodate five species in the then family Epacridaceae (now Ericaceae subfamily Styphelioideae), mostly from south-west Western Australia but including the eastern Australian species *L. pungens* (Cav.) R.Br. (syn. *Epacris pungens* Cav.). The latter species was subsequently removed to the monotypic genus *Woollsia* F. Muell. by Mueller (1874). Brown's four Western Australian species were *L. ciliatum* R.Br., *L. pentapetalum* R.Br., *L. conspicuum* R.Br. and *L. lasianthum* R.Br.

Bentham (1869:242) accepted all Brown's species except *L. pentapetalum*, which he reduced to a synonym of *L. ciliatum*, along with *L. curvatum* Lindl., *L. ovatum* Sond., *L. spicatum* Lindl. and *L. virgatum* DC. Subsequently, *L. elegans* Sond. and *L. fimbriatum* F. Muell. were described and accepted as distinct, bringing the total number of accepted taxa in the genus to five, all from Western Australia.

Following Bentham, *Lysinema ciliatum* has been regarded as a complex and variable species. A preliminary analysis of material at the Western Australian Herbarium in the 1990s by R. Cranfield (pers.

comm.) resulted in the recognition and subsequent phrase-naming of eleven informal, geographically named taxa at the rank of forma, with the expectation that further study would result in some of these being recognised at a higher rank.

In 2007, M. Bennett from the Ravensthorpe Wildflower Society drew my attention to two distinctly different morphotypes in the *L. ciliatum* complex growing sympatrically near Hopetoun. The morphotypes grew closely intermixed with no sign of intermediates or hybrids, and differed significantly in floral morphology despite overlapping in flowering time. One morphotype, with relatively few, short, chestnut-brown bracts and yellowish flowers, conformed with Cranfield's formas Mt Barren (E. & S. Pignatti 1409) and Denmark (D.H. Perry s.n. 12/1961). The other, with longer, paler flowers and more numerous, narrower bracts which were dark brown with contrasting pale margins, was similar to Cranfield's remaining formas. Subsequent field work determined that the former morphotype is widespread close to the coast from east of Esperance to west of Albany, and is frequently closely sympatric with, but always clearly morphologically distinct from, the more widespread form.

With the exception of formas Mt. Barren and Denmark, Cranfield's remaining formas are not considered here to be taxonomically distinct, but rather to comprise minor variation in a widespread and variable single species that is not appropriately divided into sub-taxa. While specimens of these forms vary in habit, inflorescence shape and leaf shape, the variation is continuous and cannot be partitioned into discrete, covarying morphotypes, nor is it well-correlated with geographic, ecological or substrate factors.

Examination of type material held at BM and K for this study reveals that Cranfield's formas Mt Barren and Denmark closely match the type of *Lysinema ciliatum* R.Br., while the more widespread taxon currently known as *L. ciliatum* matches the type of *L. pentapetalum* R.Br.

Accordingly, the circumscription of *L. ciliatum* is reduced here to encompass specimens previously referred to formas Mt Barren and Denmark, while the name *Lysinema pentapetalum* is reinstated for the majority of specimens previously ascribed to *L. ciliatum*.

Taxonomy

Lysinema ciliatum R.Br., *Prodr.*: 552 (1810).— *Epacris ciliata* (R.Br.) Poir. *Encycl. méth., Bot.*: 555 (1812), *nom. illeg. et inval.* Type citation: 'In collibus sterilibus ovides ad Bay I [Lucky Bay] ora Australis Jan. 1802' (holo: BM, photo!).

Lysinema ciliatum forma Mt. Barren (E. & S. Pignatti 1409) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum forma Denmark (D.H. Perry s.n. 12/1961) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Spreading to erect or straggling *shrubs* to 0.2–1.0 m high from a taproot, usually single-stemmed at the base but the stems often many-branched immediately above the base, producing relatively few, erect, little-branched, seasonal flowering stems; young stems moderately to densely puberulous with minute, white, straight, patent to slightly retrorse, uniform hairs *c.* 0.1 mm long. *Leaves* crowded and +/- imbricate, usually erect and appressed but often spreading on short side-branches, alternate, rather

thick, elliptic to ovate or (rarely) obovate, 2.5–8.0 × 1.0–3.0 mm, narrowed at the base into a short, obscure petiole, glabrous apart from minutely ciliolate margins mostly in the lower 1/4–1/2 and a patch of minute hairs on the base of the petiole; upper surface flat to concave, lower surface convex-keeled, with 1–several obscure nerves visible when dry; apex obtuse, +/- carinate. *Flowers* sweetly scented, solitary in upper leaf-axils, each surrounded by a cylindrical involucre of bracts[1], forming few- to many-flowered conflorescences terminal to growth units (apex growing on after flowering or determinate by abortion), these spike-like and many-flowered (to 7 cm long) when the growth unit is strong, head-like and few-flowered on short units with weak growth; bracts 12–20(–25), glossy, chestnut-brown, rigid, scarious, ovate to narrow-ovate, obtuse, ±glabrous except for ciliate margins which do not sharply contrast in colour with the body of the bract. *Corolla* cream to pale yellow; tube cylindrical to narrowly urceolate, straight, 8–12 mm long, equal to or exceeding the bracts by up to 3.5 mm; lobes 3–5 mm long, obtuse. *Stamens* free from corolla but entirely enclosed within it; anthers linear, 2.5–4.0 mm long. *Ovary* densely pubescent, 5-angled; style terminal, enclosed in corolla tube; stigma capitate, with 5 terminal stigmatic lobes; disc of 5 broadly oblong scales *c.* 1/4 – 3/4 the length of the ovary at anthesis; ovules numerous, axile. *Capsule* 3.5–5.0 mm long, pubescent, enclosed within the persistent bracts; seeds not seen. (Figure 1A)

Other specimens examined. WESTERN AUSTRALIA: 64 km E of Jerramungup, 7 Nov. 1978, *R.J. Cranfield* 1096 (PERTH 04986334); 8 km E of the Maringarup South Road and Devils Creek Road junction, 28 km E of Gairdner, 30 Nov. 1985, *D.B. Foreman* 1359 (PERTH 05047331, AD, CANB, NSW); 7 km W of Bremer Bay on Boxwood Hill to Bremer Bay Road, 1 Dec. 1985, *D.B. Foreman* 1397 (PERTH 05047358, AD, NSW, CANB, HO, K); W side of Lucky Bay, 21 Jan. 1966, *A.S. George* 7501 (PERTH 05047242); lower slopes Mount Warriup [Warriup Hill], Green Ranges, E of Cheyne Beach, 17 Nov. 1982, *G.J. Keighery* 5786 (PERTH 05047609); Jerdacuttup Lakes Reserve, ENE of Hopetoun, 15 Oct. 1983, *G.J. Keighery* 6508 (PERTH 05047420); 1 km E of Cranbrook, 8 Oct. 1983, *G.J. Keighery* 6605 (PERTH 05047404); Near Mount Barnett, [Barnett Peak] Salt River Road, Stirling Ranges, 13 Sept. 1986, *G.J. Keighery* 8402 (PERTH 5047544); Torndirrup National Park, S Albany, 28 Nov. 1986, *G.J. Keighery* 8819 (PERTH 05047668); Kululinup [Kulunilup] Nature Reserve, 21 Mar. 1997, *G.J. Keighery & N. Gibson* 2407 (PERTH 05207606); Denmark, Dec. 1961, *D.H. Perry s.n.* (PERTH 02572265); Cape Arid National Park, E of Esperance, 29 Nov. 1971, *R.D. Royce* 9839 (PERTH 05047234); along Lower Denmark Road near Bornholm. 19 Dec. 1982, *A. Strid* 21815 (PERTH 02572273); 45 km W of Israelite Bay, 1 Oct. 1968, *P.G. Wilson* 8154 (PERTH 05047455).

Distribution and habitat. Occurs mainly on the south coast and adjacent hinterlands of Western Australia between the Esperance and Denmark districts (Figure 2B), in heathlands on sand. Specimen records at PERTH suggest that there are two separate areas of distribution within this region: (1) between Mt Ragged and Butty Harbour near Esperance, and (2) between the Jerdacuttup River and Denmark. It has not been collected between Mason Bay and Butty Head; field observations are needed to show whether this apparent disjunction is real.

Three collections (F. Hort & J. Hort 2177, F. Hort & J. Hort 3392 and F. Hort, J. Hort 3394 & G. Cassis) from the Darling Range between the Brookton Highway and Albany Highway south-east of Armadale, are widely disjunct, but otherwise appear typical for the species.

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[1] In *Lysinema* as in a few other genera in Styphelioideae (e.g. *Conostephium*) there is no clear demarcation between bracts and sepals but simply a grade in size and shape from relatively short, broad basal bracts to longer, narrower ones closer to the perianth. In this paper all the parts subtending the corolla are termed bracts, as morphological recognition of a distinct set of sepals is not possible.

Figure 1. Inflorescences, photographed from dried herbarium specimens. A – *Lysinema ciliatum* (PERTH 05047668); B – *L. pentapetalum* (PERTH 02571900).

Conservation status. *Lysinema ciliatum* is widespread and occurs in many Nature Reserves and National Parks within its area of distribution.

Notes. *Lysinema ciliatum* may be distinguished from the more widespread *L. pentapetalum* by the colour of the involucral bracts surrounding each flower. In *L. ciliatum* these are uniformly pale chestnut in colour whereas in *L. pentapetalum* they are usually dull, dark brown with the marginal cilia forming a contrasting pale border (Figure 1). *Lysimena ciliatum* usually has fewer bracts than *L. pentapetalum*, although the ranges overlap (12–25 for *L. ciliatum*, 20–36 for *L. pentapetalum*). Field observations suggest that the flowers of *L. ciliatum* are usually darker in colour than *L. pentapetalum* (cream to yellow compared with white to cream) and are sweetly scented without the distinctive curry odour of *L. pentapetalum*; one specimen (*Keighery* 4951) records a curry scent for *L. ciliatum*, but this may be in error and refer to co-occurring plants of *L. pentapetalum*.

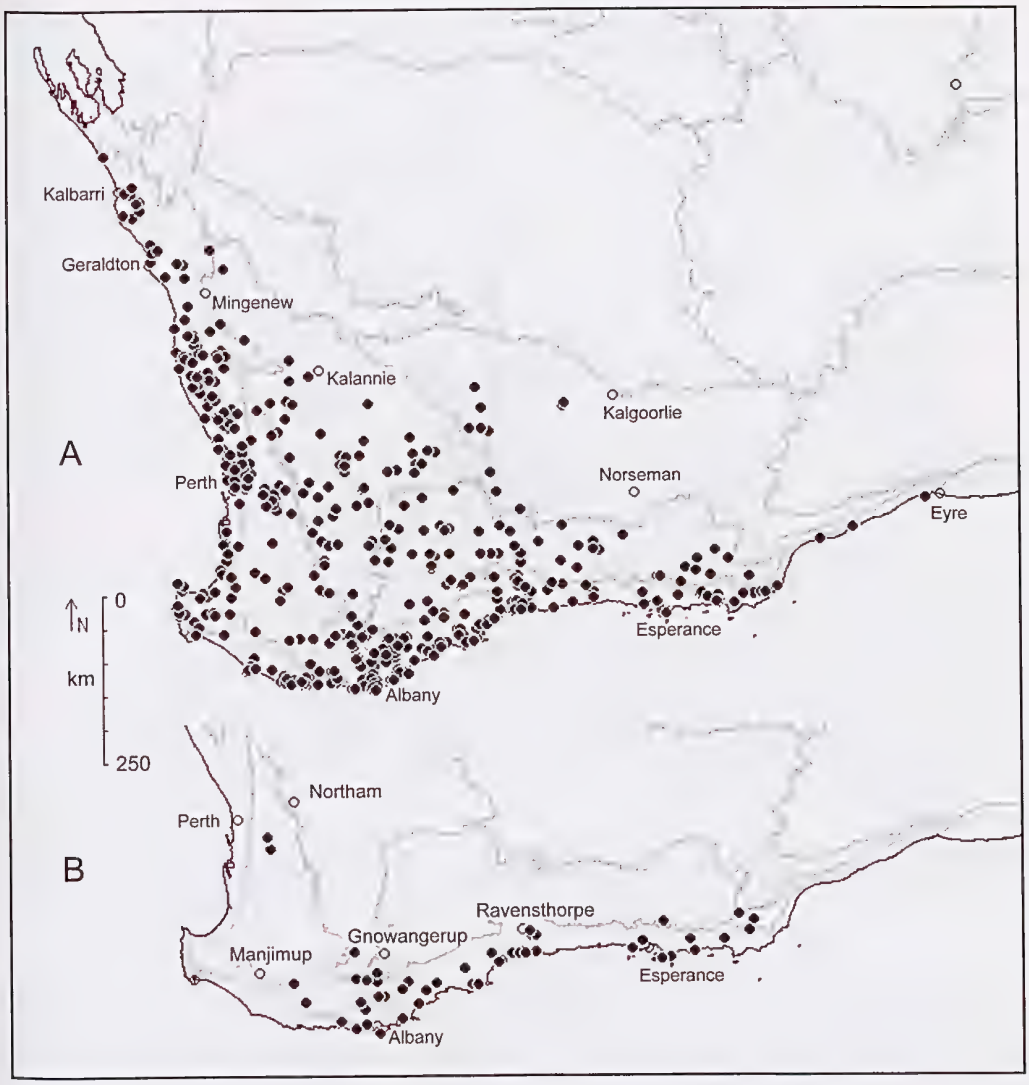

Figure 2. Distribution of *Lysinema pentapetalum* (A) and *L. ciliatum* (B) in south-west Western Australia

Mixed stands of *Lysinema ciliatum* and *L. pentapetalum* have been observed at a number of localities (e.g. Carnaby's Rd near Hopetoun, *K.R. Thiele* 3347 and 3348) and are probably common; no intermediate plants have been found at these sites, strongly suggesting that the plants are reproductively isolated and do not hybridise. The two species appear to have similar ecological ranges and preferences. Analysis of herbarium specimens indicates that peak flowering for *L. ciliatum* is slightly later than for *L. pentapetalum* (Figure 3).

As with *L. pentapetalum*, leaves of *L. ciliatum* vary greatly in size and shape, both within and between plants. In general, leaves on basal short-shoots of determinate growth are small (*c.* 2–3 mm long) and spreading, whereas leaves on long, vigorous flowering shoots are longer (to 8 mm long) and appressed. Leaves at the base of growth units tend to be broader than leaves elsewhere on the growth units. Although there is broad variation within the two species, there are also consistent differences

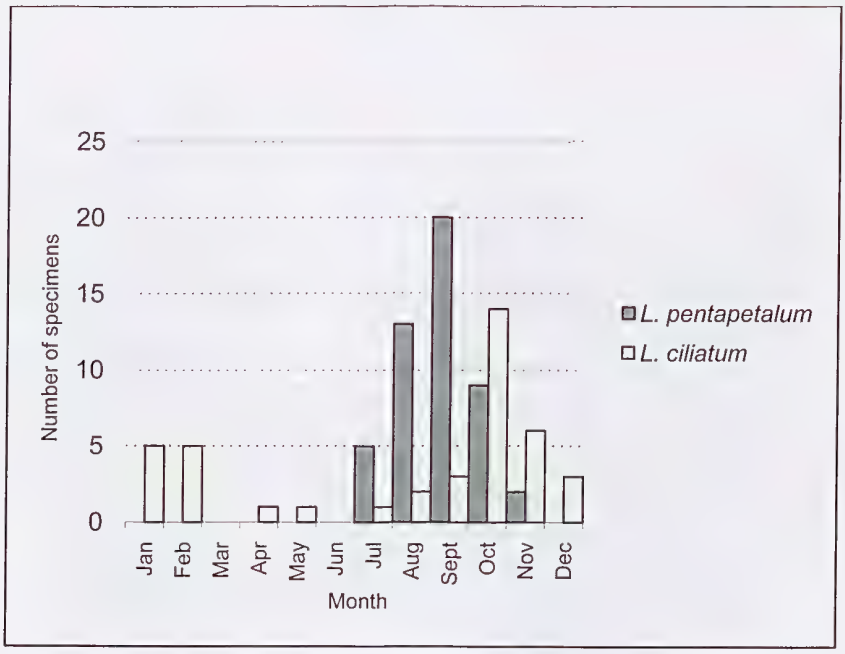

Figure 3. Collection dates for all flowering specimens held at PERTH of *Lysinema ciliatum* and sympatric collections of *L. pentapetalum* (specimen records were filtered to include only those south of 33° 30' S and east of 117° 30' E.). Peak flowering is in September for *L. pentapetalum* and October for *L. ciliatum*.

between them, with leaves of *L. ciliatum* tending to be broader and more elliptic whereas those of *L. pentapetalum* are narrower and more ovate to almost linear (Figure 4).

The shape and size of the conflorescence varies greatly also, from few-flowered 'heads' to many-flowered elongate 'spikes'. Field observations suggest that young plants with long, vigorous seasonal growth produce elongate, spike-like conflorescences, while less vigorously growing plants with short seasonal growth produce few-flowered head-like ones. The wide range of variation in these characters is considered to indicate ecological factors and is not taxonomically significant.

Figure 4. Variation in leaves in *Lysinema ciliatum* (left) and *L. pentapetalum* (right). Scale bar 10 mm.

Lysinema pentapetalum R.Br., *Prodr.*: 552 (1810).— *Epacris pentapetala* (R.Br.) Poiret, *Encycl. méth., Bot.*: 555 (1812), *nom.illeg. Type*: Port Regis Georgii IIIds [King George Sound] Dec. 1801 (holo: BM, photo!).

Lysinema spicatum Lindl., *Sketch veg. Swan R.* 1: xxv (1839).— *Lysinema virgatum* DC., in A.P. de Candolle, *Prodr.* 7(2): 765 (1839). *Type*: Swan River, Drummond, 1839 (holo: CGE, photo!, G-DC, photo!).

Lysinema curvatum Lindl., *Sketch veg. Swan R.* 1: xxv (1839). *Type*: Swan River, Drummond, 1839 (holo: CGE, photo!).

Lysinema ciliatum forma Central Wheatbelt (S. Paust 898) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum forma Esperance (G. Perry 176) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum forma Goldfields (L. Haegi 984) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum forma Jerramungup (N.G. Marchant 70/234) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum forma Lake King (J.S. Beard 3698) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum forma north of Perth (N. Sammy s.n. 15/8/1985) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum forma Perth limestone (W. Ives s.n. 9/8/1960) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* 241 (2000).

Lysinema ciliatum forma Perth-Bunbury sands (J.W. Green 351) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum forma S.W. Coastal (N.G. Marchant 71/719) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 241 (2000).

Lysinema ciliatum auct. non R.Br.

Spreading to erect or straggling *shrubs* to 0.2–1.0 m high from a taproot, usually single-stemmed at the base but the stems often many-branched immediately above the base, producing relatively few, erect, little-branched, seasonal flowering stems; young stems moderately to densely pubescent with white, +/- flexuous, retrorsely-appressed, +/- interwoven hairs to 0.25 mm long. *Leaves* crowded and +/- imbricate, usually erect and appressed but often spreading on short-side branches, alternate, rather thick, narrowly ovate to almost linear, 2–10 × 1.0–2.5 mm, narrowed at the base into a short, obscure petiole, glabrous apart from minutely ciliolate margins and a patch of minute hairs on the base of the

petiole; upper surface flat to concave, lower surface convex-keeled, with 1–several obscure nerves visible when dry; apex obtuse, +/- carinate. *Flowers* with a sweet musky scent reminiscent of curry, solitary in upper leaf-axils, each surrounded by a cylindrical, involucre of bracts, forming few- to many-flowered conflorescences terminal to growth units (apex growing on after flowering or determinate by abortion), these spike-like and many-flowered (to 15 cm long) when the growth unit is strong, head-like and few-flowered on short units with weak growth; bracts 20–36, dark, dull brown, rigid, scarious, ovate to narrow-ovate to almost linear, obtuse, the densely pale-ciliate margins contrasting sharply with the body of the bracts. *Corolla* white to cream sometimes with pink tinges in bud; tube cylindrical to narrowly urceolate, straight or sometimes curved, (6–)10–18 mm long, equal to or exceeding the bracts by up to 3.5 mm; lobes 3–6 mm long, obtuse. *Stamens* free from corolla but entirely enclosed within it; anthers linear, 4–5 mm long. *Ovary* densely pubescent, 5-angled; style terminal, enclosed in corolla tube; stigma capitate, with 5 terminal stigmatic lobes; disc of 5 broadly oblong scales *c.* 1/2 to as long as the ovary at anthesis; ovules numerous, axile. *Capsule* 5–8 mm long, pubescent, enclosed within the persistent bracts; seeds *c.* 1.5–1.8 × 0.5 mm, linear, pale reddish-brown. (Figure 1B)

Other specimens examined. WESTERN AUSTRALIA: Rabbit proof fence towards Starvation Boat Harbour, 10 Aug. 1965, *Anonymous* 16155 (PERTH 05026881); Emu Point Reserve, Albany, 17 July 1967, *E.M. Bennett* 1989 (PERTH 05027063); W boundary of John Forrest National Park, 1.5 km along Throssell Road, off York Road, 16 Aug. 1986, *A.R. Chapman* 321 (PERTH 05043964, NSW, HO); Jarrah Road, South Perth, 8 Aug. 1978, *R.J. Cranfield* R64 (PERTH 03012115); 26 km due SW of Bodallin, 17 Sept. 1982, *R.J. Cranfield* 2476 (PERTH 05044030); *c.* 13 km E of estuary of the Oldfield River (Oldfield River is ca 100 km W of Esperance), 12 Oct. 1968, *N.N. Donner* 2997 (PERTH 05026911, AD); *c.* 2 miles [*c.* 3 km] N of Wongan Hills, 9 Aug. 1959, *A.S. George* 83 (PERTH 05043824); 7.8 km S of Cheritons Find–Forrestania Road junction, 23 Sep. 1989, *N. Gibson* 0031 (PERTH 05044065); 1 km inland from sea, Boat Harbour, 100 km due E of Albany, 14 Aug. 1970, *N.G. Marchant* 70/234 (PERTH 02572346); Frank Hann National Park, 11 July 1978, *D. Monk* 28 (PERTH 05043530); Maylands, Aug. 1919, *Mrs. Pelloe s.n.* (PERTH 05047137); 26 km by road (*c.* N) from Hopetoun on Ravensthorpe–Hopetoun road, 5 Aug. 1974, *G. Perry* 92 (PERTH 05044146); 6 km W of Tammin on Great Eastern Highway, 5 Aug. 1979, *J.M. Powell* 1131 (PERTH 05043808, CANB, HO, L, K, NSW); *c.* 1 km S of Cape Naturaliste Lighthouse on road to Dunsborough, 13 Aug. 1979, *J.M. Powell* 1144 (PERTH 05026504, AK, BISH, CANB, L, K, NSW); junction of Cowalellup Road and northern road to Ongerup, 3 Aug. 1986, *J.M. Powell* 2423 (PERTH 05026814, NSW, HO); 5 km W of Lake King, 5 Aug. 1968, *R.A. Saffrey* 587 (PERTH 05043603); 33.6 km from Port Gregory along Yerina Springs road, heading towards Binnu crossroads, 15 Aug. 1985, *N. Sammy s.n.* (PERTH 02572508); mainland, 12 miles [*c.* 19 km] N of Jurien Bay, 22 Oct. 1961, *G.M. Storr s.n.* (PERTH 02570475); Harrismith, 0.5 km E of township, Roe District, 26 Sep. 1979, *J. Taylor* 899, *M.D. Crisp, & R. Jackson* (PERTH 05043697, CANB); Near Forestry Station, Gnangara, July 1957, *C.L. Wilson s.n.* (PERTH 05026741).

Distribution and habitat. Widespread almost throughout the South West Botanical Province from Kalbarri National Park to Israelite Bay (Figure 2A), in heathlands and heathy woodlands and forests on sandy soils. The eastern margin of distribution is more or less concurrent with the clearing line of the wheatbelt, although a small number of collections come from pastoral country east of the wheatbelt (e.g. Brontie Station between Southern Cross and Kalgoorlie, 18 km NW of Bullabulling). The easternmost collection is on the Great Australian Bight south of Cocklebiddy.

Within this range, *L. pentapetalum* occurs on a wide range of substrates, from travertine and lime-rich, coastal dunes to inland, acid sand-plains and from well-drained to winter-wet sites.

Conservation status. *Lysinema pentapetalum* is common and widespread, and occurs in many National Parks and Nature Reserves.

Notes. Not surprisingly, given the wide ecological range of the species, plants of *L. pentapetalum* show a great deal of variation, particularly in leaf dimensions and form (Figure 4), corolla length and conflorescence shape. Leaves and conflorescences vary in a similar manner to *L. ciliatum* (discussed above). Corollas are generally longer than in *L. ciliatum*.

A small number of short-flowered specimens (corolla tube 6–10 mm long) have been collected from exposed, coastal heaths between Point D'Entrecasteaux and Cheyne Beach (e.g. J.M. Powell 2643, G.J. Keighery 8557, V. Mann & A.S. George 121, and N.G. Marchant 71/719). These differ also in habit from typical *L. pentapetalum*, being short, dense, and much-branched rather than slender and little-branched; however, the exposed, coastal locations may account for this variation. These specimens are provisionally included in *L. pentapetalum* until field observations can determine their status.

As with *L. ciliatum*, the variation exhibited by *L. pentapetalum*, while striking, is continuous and is neither partitioned nor co-varying; it is considered here to represent ecological rather than taxonomic variation.

Other names in *Lysinema*

The following names in *Lysinema* are not discussed above; their synonymy is dealt with here for completeness.

Lysinema attenuatum (Lodd.) Link, *Enum. hort. berol. alt.* 1: 211 (1821). *Type*: *n.v.* = *Woollsia pungens* (Cav.) F.Muell. *fide* APNI (2009).

Lysinema brevilimbatum F.Muell., *Fragm.* 3(22): 142 (1863). *Type*: In locis humidis ad Kalgan. Aug. Oldfield, *n.v.* = *L. lasianthum* R.Br. *fide* Bentham (1869).

Lysinema ciliatum var. ericoides Ostenf., *Biol. Meddel. Kongel. Danske Vidensk. Selsk.* 3(2) (1921). *Type*: Tammin, on sandy heath (No. 937; 6 Oct. 1914), K?, *n.v.* From the locality this is almost certainly a junior synonym of *L. pentapetalum*.

Lysinema ciliatum var. gracile Wawra, *Itin. princ. S. Coburgi* 1: 75 (1883). *Type*: Australien. King George's sound. Coll. I 872 b. W? *n.v.* This is almost certainly a junior synonym of either *L. ciliatum* or *L. pentapetalum*.

Lysinema ewartianum Domin, *Věstn. Král. České Společn. Nauk. Tř. Mat.-Přír.* 2(2): 102 (1923). *Type*: W.A.: Bridgetown to Kojonup and Slab Hut Gulley, A.A. Dorrien-Smith, PR?, *n.v.* From the locality this is almost certainly a junior synonym of *L. pentapetalum*.

Lysinema ovatum Sond., *Plant. Preiss.* 1(3): 329 (1845). *Type*: In glareosis promontorii Cape Riche, d. 20. Nov. 1840. Herb. Preiss. No. 443., MEL? *n.v.* This is almost certainly a junior synonym of either *L. ciliatum* or *L. pentapetalum*.

Lysinema purpurascens (Sims) Courtois, *Mag. Hort. (Liège)*: 105 (1833). *Type*: none cited *n.v.* = *Epacris purpurascens* Sims, ?= *Epacris purpurascens* R.Br. This is a NSW plant.

Lysinema roseum Courtois (as '*rosea*'), *Mag. Hort. (Liège)*: 240 (1833). *Type*: none cited *n.v.* Probably = *Woollsia pungens* (Cav.) F.Muell.

Lysinema ruscifolium Sieber ex Spreng., *Syst. Veg.* 4(2): Cur. Post. 64 (1827). *Type*: Nov. Holl. *n.v.* Probably = *Woollsia pungens* (Cav.) F.Muell.

Lysinema sieberi Benth., *Enum. pl.*: 76 (1837). *Type*: none cited *n.v* = *Woollsia pungens* (Cav.) F.Muell. fide Bentham (1869).

Key to the species of *Lysinema*

1. Flowers well-separated on a 1-sided spike ..... **L. lasianthum**

1: Flowers few together or forming a dense terminal head or spike

2. Anthers and stigma distinctly exserted from the corolla-tube ..... **L. elegans**

2: Anthers and stigma included in the corolla-tube

3. Leaves and bracts attenuate-acuminate ..... **L. conspicuum**

3: Leaves and bracts obtuse to acute, not attenuate

4. Bracts fringed with irregularly lacerate lobes ..... **L. fimbriatum**

4: Bracts ciliate, not irregularly lacerate-lobed

5. Bracts 12–20(–25), chestnut-brown without a contrasting pale margin; leaves elliptic to ovate or (rarely) obovate ..... **L. ciliatum**

5: Bracts 20–36, usually dull brown with a contrasting pale-ciliate margin; leaves linear to narrowly ovate ..... **L. pentapetalum**

Acknowledgments

I would like to thank Mike Hislop for pointing out to me that the *Lysinema ciliatum* complex required systematic study, and Merle Bennett and the Ravensthorpe Wildflower Society for bringing to my attention the two forms of *Lysinema ciliatum* co-occurring near Hopetoun and for facilitating a field trip. Russell Barrett kindly agreed to search for and photograph types in a number of European herbaria, while Tony Orchard, as Australian Botanical Liaison Officer at Kew, helped track down and photograph others; this help was instrumental in resolving the taxonomy in the group. Ray Cranfield, Mike Hislop and Fred and Jean Hort shared their knowledge of the genus; in addition, Mike Hislop provided valuable comments on the manuscript.

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Banksia recurvistylis (Proteaceae), a new species from Western Australia

Kevin R. Thiele

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
Email: kevin.thiele@dec.wa.gov.au

Abstract

Thiele, K.R. *Banksia recurvistylis* (Proteaceae), a new species from Western Australia. *Nuytsia* 19(2): 277–281 (2009). *Banksia recurvistylis* K.R.Thiele is described to accommodate anomalous populations previously referred to *B. meganotia* (A.S.George) A.R.Mast & K.R.Thiele. The new species differs from *B. meganotia* in its habit and flower and leaf dimensions, and is geographically disjunct. Both *B. meganotia* and *B. recurvistylis* have relatively restricted distributions and are of conservation significance.

Introduction

Banksia L.f., including the former genus *Dryandra* R.Br., comprises 212 taxa distributed in south-western, eastern and northern Australia with one species extending to Papua New Guinea and adjacent parts of Indonesia. The centre of species diversity is in south-west Western Australia, particularly in areas with sandy and lateritic soils. *Dryandra*, long established as a separate genus, was included in *Banksia* by Mast & Thiele (2007) as it is phylogenetically nested within it.

Banksia meganotia (A.S.George) A.R.Mast & K.R.Thiele was described by George (1996, as *Dryandra meganotia*) in the small series *Capitellae* A.S.George along with *B. serratuloides* (Meisn.) A.R.Mast & K.R.Thiele. It is restricted to an area in the Avon bioregion (Department of the Environment, Water, Heritage and the Arts 2008) east of Narrogin, between Jitarning, Harrismith and Yilliminning Rock, in sand and clay-sands over laterite, sometimes associated with granite rocks. It forms a spreading to erect shrub to 1m high from a lignotuber, and has more or less columnar stems densely clothed with leaves borne on short, lateral shoots. The lignotuber allows the plant to resprout after fire.

Plants collected in Wandering and Monadnocks Conservation Parks by Fred and Jean Hort between 2003 and 2008 were originally referred to *B.* aff. *meganotia* and subsequently to the informal phrase name *B.* sp. Wandering (F. & J. Hort 3181). These populations are disjunct by *c.* 80 km to the north-west of the nearest populations of *B. meganotia*, and are in the Jarrah Forest bioregion. They differ from *B. meganotia* in being fire-killed, non-lignotuberous, taller shrubs with significantly larger flowers and leaves. They are described here as the new species *B. recurvistylis* K.R.Thiele.

Taxonomy

Banksia recurvistylis K.R.Thiele, *sp. nov.*

Banksiae meganotiae affinis sed lignotubere carenti, floribus et foliis longioribus differt.

Typus: Wandering, Western Australia [precise locality withheld for conservation reasons], 10 November 2008, *F. Hort* 3369 (*holo*: PERTH 07702604; *iso*: CANB, K).

Banksia sp. Wandering (F. & J. Hort 3181), Western Australian Herbarium, in *FloraBase*, http://www.florabase.dec.wa.gov.au [accessed 20 December 2008].

Non-lignotuberous *shrubs* to *c.* 2 m high and 3 m wide, single-stemmed at the base. *Stems* shortly tomentose. *Leaves* pinnatipartite, densely crowded on short shoots lateral to the main stems, 8–11 cm long, 22–35 mm wide, the midrib usually curved; lobes 10–14 each side, at *c.* 70°–90°, very narrowly triangular, acute, pungent, the margins revolute, sparsely pilose when young with long, straight hairs, soon glabrous adaxially, densely woolly abaxially, the hairs closely filling the grooves between the midrib and margins. *Inflorescences* on short, lateral branches; *involucral bracts* narrowly ovate to linear, obtuse, pilose abaxially and on the margins, ± glabrous adaxially except for a few short hairs towards apex, the innermost 20–30 mm long; floral bracts linear, 6–10 mm long, loosely hirsute. Flowers 25–40 per head, pale yellow; *perianth* 32–38 mm long, silvery-pilose above, glabrous at base; limb 8–10 mm long. *Pistil* 44–55 mm long, evenly strongly curved outwards after anthesis, hirsute in lower third, glabrous distally; pollen presenter 4–5 mm long, narrowly cylindrical, obscurely ribbed. *Follicles* 4–6 mm long, densely brown-pilose. (Figures 1, 2)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 9 Dec. 2003, *F. Hort* 2143 (PERTH); 19 Jan. 2008, *F. Hort* 3180 (PERTH); 20 Jan. 2008, *F. & J. Hort* 3181 (PERTH); 23 Jan. 2008, *F. Hort, J. Hort & B. Hort* 3182 (PERTH); 25 Jan. 2008, *F. & J. Hort* 3187 (PERTH).

Distribution. Known from five populations, one in the Wandering Conservation Park east of Bannister, and four in a small area of the Monadnocks Conservation Park south of Sullivan Rock. The Monadnock populations are spread over a distance of *c.* 4 km, while the Wandering population is *c.* 40 km distant to the south-east (Figure 3).

Habitat. All known populations are found in or adjacent to heath patches on shallow, lateritic soils associated with granite outcrops, within jarrah-marri forest. Characteristic associated species include *Allocasuarina humilis*, *Andersonia* spp., *Grevillea bipinnatifida*, *Hakea undulata*, *H. trifurcata*, *H. petiolaris*, *Isopogon dubius*, *Verticordia* spp. and *Xanthorrhoea preissii*.

Phenology. Flowers in November and early December

Conservation status. Banksia recurvistylis was listed as Priority Two under the informal synonym *Banksia* sp. Wandering (F. & J. Hort 3181) by Atkins (2008); this remains appropriate. Population estimates at each population range from 70 to 600 plants. All populations are in gazetted Conservation Parks; however, all areas are potentially threatened by *Phytophthora cinnamomi* dieback which is prevalent in the area.

Figure 1 – Holotype of *Banksia recurvistylis* K.R.Thiele (PERTH 07702604), scale = 5 cm. Note that the precise locality for this conservation taxon has been blurred.

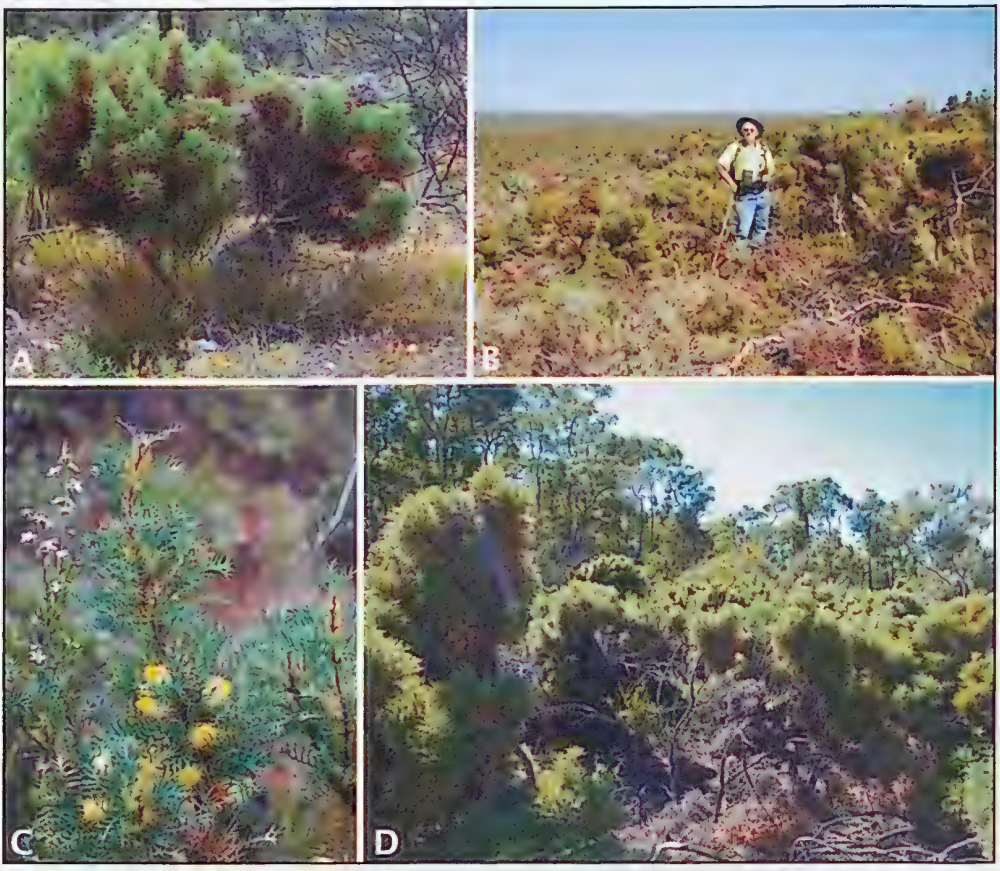

Figure 2. *Banksia recurvistylis*. A – individual shrub (the two stems visible arise above ground level from a non-lignotuberous base); B – typical habitat on edge of a granite sheet (Fred Hort, one of the discoverers of the species, provides scale in front of a dense patch of *B. recurvistylis*); C – inflorescences; D – patch of large, senescent individuals on granite sheet in jarrah forest. All photographs – J. Hort.

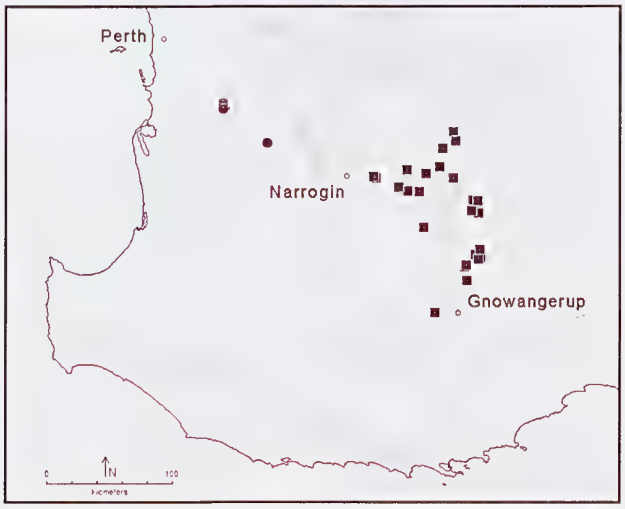

Figure 3. Distribution of *Banksia recurvistylis* (●) and *B. meganotia* (■) in south-west Western Australia.

Affinities. *Banksia recurvistylis* resembles (and is almost certainly closely related to) *B. meganotia*, sharing with it similar leaf morphology, strongly recurved styles after anthesis (an unusual feature in the genus), very small follicles and seeds with poorly-developed wings. It differs from that species in being disjunctly larger in all its parts than *B. meganotia*; the two taxa can be distinguished using the measurements in Table 1.

Table 1. Morphological differences between *Banksia recurvistylis* and *B. meganotia*

	B. recurvistylis	***B. meganotia***
Lignotuber	Absent	Present
Leaves (length × width)	8–11 cm × 22–35 mm	3–7 cm × 10–25 mm
Perianth (length)	32–38 mm	22–23 mm
Pistil (length)	44–55 mm	26–30 mm

Etymology. From the Latin *recurvus* (curved backwards) and *stylus* (a style), in reference to the styles that are distinctly recurved in older flowerheads.

Acknowledgments

I would like to acknowledge Fred and Jean Hort for their diligence and expertise in surveying the flora of the Darling Range for new and noteworthy species. They brought this species to my attention, showed it to me in the field and collected excellent specimens from all known populations. Juliet Wege, Kelly Shepherd and an anonymous reviewer provided invaluable comments on the manuscript.

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Three new species of *Hibbertia* (Dilleniaceae) from Western Australia

Kevin R. Thiele

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
Email: kevin.thiele@dec.wa.gov.au

Abstract

Thiele, K.R. Three new species of *Hibbertia* (Dilleniaceae) from Western Australia. *Nuytsia* 19(2): 283–293 (2009). Three new species, *Hibbertia leucocrossa* K.R.Thiele, *H. fasciculiflora* K.R.Thiele and *H. propinqua* K.R.Thiele are described as new. All taxa occur north of Perth in the Lesueur Sandplains subregion of the Geraldton Sandplains bioregion in the South West Botanical Province, Western Australia. A revision of a key to the *Hibbertia* species of Western Australia is provided.

Introduction

Hibbertia Andrews comprises *c.* 112 taxa in Western Australia. The great majority of species occur in the South West Botanical Province, with smaller numbers in the Eremaean and Northern Botanical Provinces.

Traditionally, *Hibbertia* has been divided into up to seven sections, principally on the basis of androecial arrangement, particularly the symmetry of the androecium, freedom or connation of staminal filaments, and presence or absence and distribution of staminodes. Horn (2005), following a molecular phylogenetic analysis based on nuclear and chloroplast genomes, demonstrated that these prior classifications are poor representations of phylogeny. He divided *Hibbertia* into two well-supported subgenera, subgen. *Hemistemma* (Thouars) Horn and subgen. *Hibbertia* (Horn, 2009). All taxa in subgen. *Hibbertia* have an actinomorphic androecium (i.e. with stamens arranged all around the carpels), but subgen. *Hemistemma* includes clades with varied androecial arrangements including both actinomorphy and zygomorphy (i.e. with stamens all on one side of the carpels); these conditions appear to have arisen several times independently. Taxa which have stamens fused into bundles comprise a single, well-supported clade within subgen. *Hibbertia*.

In addition to staminal arrangements, Horn (2005, 2009) showed that leaf morphology and indumentum are also phylogenetically informative. All taxa with ericoid, needle-like leaves in which the leaf margin is consistently strongly revolute to the midrib, thus hiding the undersurface, are in subgenus *Hemistemma*. In contrast, subgen. *Hibbertia* mostly comprises taxa with leaves that have flat or slightly recurved margins that leave the undersurface exposed.

The most recent complete revision of *Hibbertia* was that of Bentham (1863). A number of eastern Australian species complexes have been revised by Toelken (1995, 1998, 2000). Wheeler (2002a,b,c,d; 2004a,b) has described many new taxa from Western Australia, while Wheeler (2004c) provided a key to all Western Australian taxa known at that time.

A number of potentially new Western Australian taxa within *Hibbertia* are currently known only by phrase names, mostly recognised by Wheeler while curating material at the Western Australian Herbarium. The present paper formally describes taxa segregated by Wheeler under the phrase names *H.* sp. Tathra (M.A. Langley & J.M. Harvey 1873) and *H.* sp. Warradarge (M. Hislop 1933). Close investigation of the former taxon for this paper showed that it comprises two closely related taxa. All taxa in this paper occur north of Perth between Eneabba and the Moore River, in the Lesueur Sandplains subregion of the Geraldton Sandplains bioregion in the South West Botanical Province.

Taxonomy

Hibbertia leucocrossa K.R.Thiele, *sp. nov.*

Hibbertiae desmophyllae affinis sed foliis dispersis grandioribus glabrescentiis, sepalis ciliatis differt.

Typus: junction of Brand Highway and Coorow – Green Head Road East, Western Australia, 30° 03' 21" S, 115° 19' 47" E, 1 December 2008, *K.R. Thiele* 3705 (*holo*: PERTH 08034893; *iso*: AD, CANB, K).

Hibbertia sp. Warradarge (M. Hislop 1933), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed October 2009].

Spreading to ± erect, multi-stemmed *shrub* to 30(–50) cm high, abundantly suckering from the rootstock, with papery bark exfoliating in narrow strips; young stems ± cylindrical, cobwebbed with dense, white, appressed to ± spreading, curled to crisped, simple hairs; older stems glabrescent. *Leaves* erect to spreading, scattered, sessile, green or glaucous, narrowly obovate often appearing linear, 20–30(–40) mm long, (0.8–)2–3(–4) mm wide, sparsely hairy with simple, white, curled or crisped hairs on both surfaces when young soon becoming glabrous except for a fringe of white, marginal hairs at the base; margins narrowly revolute, not obscuring the abaxial surface in broad leaves, meeting below and obscuring both the abaxial surface and the midrib in narrow leaves particularly when dry; base slightly expanded but not stem-clasping; apex obtuse, rarely subacute, straight. *Flowers* solitary, sparse, terminating branches and short lateral shoots, ± sessile; *primary bract* scarious, narrowly triangular-acuminate, 3–4 mm long, *c.* 1 mm broad, acute, glabrous to sparsely pilose adaxially and abaxially, long-ciliate on the margin, ± basal on the peduncle (if present); *accessory bracts* absent. *Sepals* 5; outer sepals ovate, attenuate and thickened at the apex but not pungent, (6–)8–9(–10) mm long, ± glabrous to moderately pubescent with appressed to ± spreading, curled to crisped, white, simple hairs denser on the margins and forming a ciliate fringe; midrib ribbed but not prominently so; inner sepals similar to the outer but with sparser indumentum. *Petals* 5, yellow, obovate, 10–12 mm long, emarginate. *Stamens* 15–21, in 5 bundles each with 2–6 connate stamens (sometimes with one stamen in the bundle not connate); filaments *c.* 2 mm long; anthers oblong-obovoid, 1.5–2.0 mm long, dehiscing by longitudinal slits; staminodes absent. *Carpels* 3, compressed-globular, glabrous; styles lateral at apex and spreading, *c.* 2.5–3.0 mm long. *Ovule* 1 per carpel. *Fruiting carpels* not seen. (Figure 1)

Figure 1. Holotype of *Hibbertia leucocrossa*. Scale bar = 5 cm.

Other specimens examined (all PERTH). WESTERN AUSTRALIA: layby off Brand Highway, 4 km S of Green Head turnoff, 27 May 1997, *R. Davis* 3224; Hill [?] km NE of Mount Lesueur, NE of Jurien, 17 Nov. 1979, *E.A. Griffin* 2530; Brand Hwy, near low voltage powerline, N of Tootbardi Rd, NE of Jurien, 1 Dec. 1992, *E.A. Griffin* 8007; E side Banovich Rd 1200 m from junction with Jurien East Rd, 8 Feb. 2006, *M. Hayes* 461; in large block of renmnant vegetation in private farmland (Breakaway, J. & J. Browne) off Green Head–Coorow road, *c.* 3 km W of Brand Highway, 28 Oct. 1995, *M. Hislop* 222; large block of remnant vegetation (SE boundary) on private farmland (Breakaway, J. & J. Browne) adjacent Brand Highway, *c.* 2 km S of junction of Coorow–Green Head road, 29 June 1997, *M. Hislop* 783; Hi Vallee property (D. & J. Williams), Warradarge, above NW head of main valley, 23 Oct. 1999, *M. Hislop* 1747; Hi Vallee property (D. & J. Williams), Warradarge, upland to N of main valley, 6 Dec. 1999, *M. Hislop* 1933; *c.* 500 m S of Woolmulla Road on Grover Road, *c.* 36 km NNE of Jurien, 20 Jan. 1996, *B.J. Lepschi & T.R. Lally* 2453; near E border of Nambung National Park, region of Mullering Brook, 29 Nov. 1974, *R. Pullen* 9723.

Distribution. Occurs in the vicinity of Warradarge Hill, on the Gairdner Range and north-east of Green Head in the Geraldton Sandplains IBRA Bioregion (Department of the Environment, Water, Heritage and the Arts, 2008) (Figure 2).

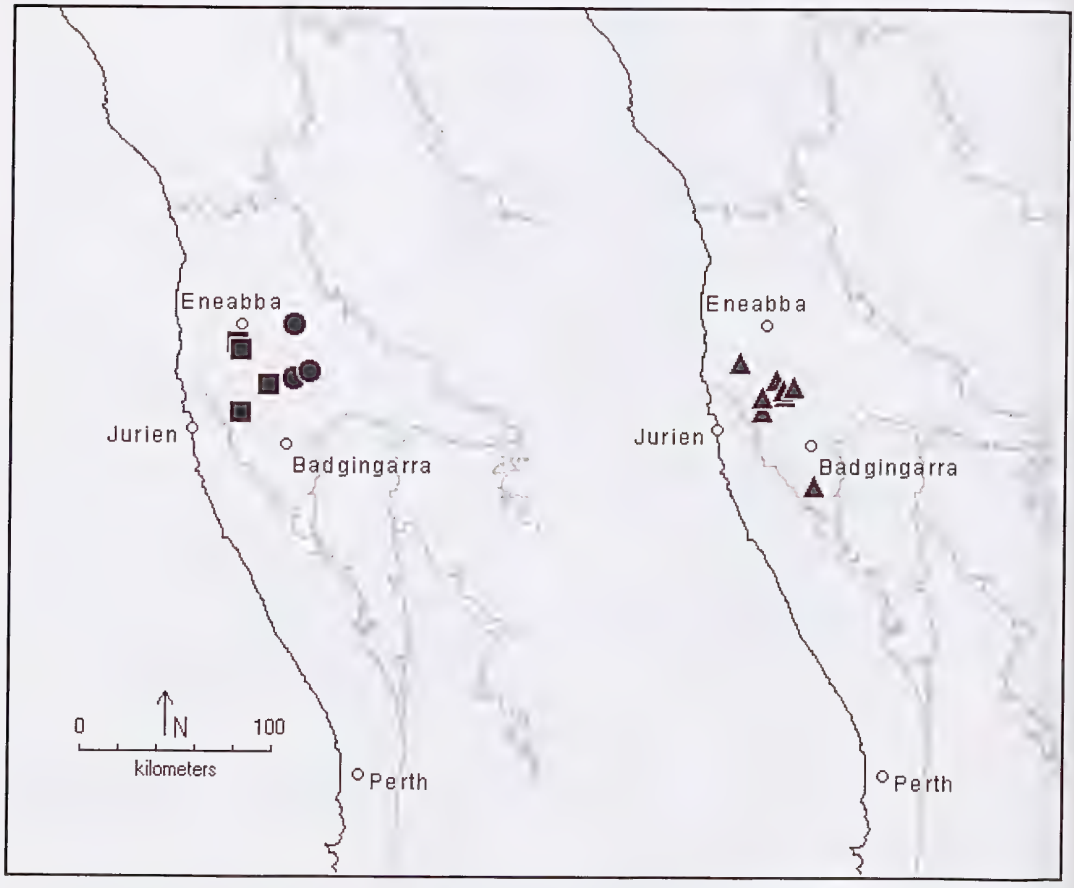

Figure 2. Distribution of *Hibbertia leucocrossa* (▲), *H. fasciculiflora* (●) and *H. propinqua* (■). Shaded lines show the boundaries of IBRA6.1 subregions (Department of the Environment, Water, Heritage and the Arts 2008); all specimens are within Geraldton Sandplains subregion GS2, the Lesueur Sandplain.

Habitat. Recorded from low, open woodland over heath, dominated by *Eucalyptus todtiana*, *E. gomphocephala*, and/or *Banksia* spp., on grey to white sand over laterite.

Phenology. Appears to flower sporadically throughout the year, probably in response to rainfall, with a peak in spring and summer (October to February).

Conservation status. Although of relatively restricted distribution (range *c.* 75 km × 20 km) the species appears to be common and occurs in several Nature Reserves and National Parks including Lesueur National Park and Coomallo Nature Reserve. The suckering/resprouting habit allows it to regrow quickly after disturbance, and it sometimes occurs abundantly along road verges where it is occasionally graded.

Etymology. From the Greek *leukos*, white, and *krossos*, a fringe, in reference to the distinctive fringe of white, cobwebby hairs at the leaf basal margins.

Affinities. The presence of connate staminal filaments places *Hibbertia leucocrossa* in subgen. *Hibbertia*. It appears to be closely related to *H. desmophylla* (Benth.) F.Muell., a species distributed from Kalbarri National Park to near the Moore River (and hence sympatric with it). *H. desmophylla* differs from *H. leucocrossa* in having generally smaller, more or less distinctly fascicled leaves which retain an indumentum of crisped, simple, white hairs to maturity, and sepals which lack a ciliate fringe. *Hibbertia leucocrossa* is also similar to an undescribed taxon known by the phrase name *H.* sp. Gnangara (J.R.Wheeler 2329), which differs in having distinctly fasciculate leaves which have a more persistent indumentum, abundantly pilose sepals, and broad, pale, papery bracts subtending the flowers.

Hibbertia fasciculiflora K.R. Thiele, *sp. nov.*

Species propria foliis ad extremitates surculorum valde fasciculatis, floribus e pedunculis longis glabris inter verticillum foliorum exorientiis.

Typus: Tathra National Park, *c.* 1.8 km south of the Eneabba – Carnamah Road, *c.* 200 m west of Garibaldi Road, Western Australia, 29° 49' 06" S, 115° 31' 16" E, 20 September 2008, *K.R. Thiele* 3689 (*holo*: PERTH 07915098; *iso*: AD, CANB, K).

Hibbertia sp. Tathra (M.A. Langley & J.M. Harvey 1873), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed October 2009], *p.p.*

Erect to spreading *shrubs* to 50 cm high, single-stemmed at base, the lower stems deeply fluted with papery bark exfoliating in flakes; young stems angular-winged below the leaf insertions, smooth, glabrous or sometimes with sparse, minute (*c.* 0.1 mm long), white, stellate hairs at first, soon glabrescent. *Leaves* spreading, borne in dense fascicles at the ends of growth units (with few or no leaves between the fascicles), indistinctly petiolate, green, linear to narrowly oblong, 12–20 mm long, (1.0–)1.5–2.0 mm wide; adaxial surface ± distinctly tuberculate, when young with sparse, spreading, hook-tipped hairs and minute stellate hairs arising from the tubercles, soon glabrescent; abaxial surface densely stellate-hairy (obscuring the surface), the midrib ± glabrous or with sparse, long, simple hairs; margins ± flat to recurved, often becoming revolute on drying and obscuring the abaxial leaf surface; base slightly expanded, adaxially finely and densely pubescent with short (0.1–0.3 mm), white, stellate hairs; apex straight-apiculate, non-pungent. *Flowers* borne amongst leaf-fascicles, distinctly slender-pedunculate, the peduncles 10–35 mm long, glabrous; *primary bract* borne immediately below the

flower, ± scarious, narrowly triangular to narrowly ovate, 4.0–5.5 mm long, 0.4–0.6 mm broad, acute, pilose adaxially and abaxially with long, spreading, stellate hairs; *accessory bracts* 4–8, similar in size, shape and indumentum to the primary bract, borne at the base of the peduncle amongst the leaf whorls. *Sepals* 5; outer sepals ovate, attenuate and thickened at the apex but not pungent, 5.0–6.5 mm long, firm-textured, pilose outside with long, spreading, simple, white hairs overlying minute stellate hairs, with hooked hairs towards the base, all hairs tubercle-based, shortly pubescent inside in the upper half; midrib prominent; inner sepals broader and shorter than the outer ones, less hairy and with a broad, ± glabrous, scarious margin. *Petals* 5, yellow, obovate, 8–12 mm long, emarginate. *Fertile stamens* 8–10, all on one side of the carpels; filaments, *c.* 1 mm long; anthers obloid, 1.5–2.0 mm long, dehiscing by short, longitudinal slits at the apex; staminodes present, usually 1–2 each side of the fertile stamens. *Carpels* 2, globular, densely pubescent; styles lateral, curved, *c.* 1.5 mm long. *Ovules* 2 per carpel. *Fruiting carpels* not seen. (Figure 3)

Other specimens examined (all PERTH). WESTERN AUSTRALIA: on vacant Crown Land, immediately S of Alexander Morrison National Park, 7 Sep. 1979, *E.A. Griffin* 2198; quadrat WM 017, Tathra National Park, 1.8 km S of Eneabba–Carnamah Road, 175 m W of Garibaldi Road, W of second firebreak, Carnamah Shire, 15 Oct. 1998, *M.A. Langley & J.M. Harvey* 1874; quadrat WM 35, Alexander Morrison National Park, north western block, E of NW corner, 21 Oct. 1998, *M.A. Langley & J.M. Harvey* 1873; quadrat WMA35, Alexander Morrison National Park, A 29804, Shire of Coorow, Central block, northern boundary between Garibaldi –Willis and Chatfield Clarke Roads, 27 Sep. 1999, *M.A. Langley & P.M. Smith* MAL 2106; 25 km E of Eneabba along road to Winchester, Irwin district, 30 Sep. 1979, *J. Taylor, M.D. Crisp & R. Jackson* JT 984.

Distribution. Occurs between Tathra and Alexander Morrison National Parks, east and southeast of Eneabba in the Geraldton Sandplains IBRA Bioregion (Department of the Environment, Water, Heritage and the Arts, 2008). Its distribution is closely parapatric to *H. propinqua*, occurring immediately to the east of that species (Figure 2).

Habitat. Recorded from low, open *Eucalyptus* and *Banksia* woodlands and heath (kwongan), in pale grey to yellow sand and sandy loams, usually over laterite or close to laterite breakaways.

Phenology. All flowering specimens have been collected in September.

Conservation status. Although of relatively restricted distribution (range *c.* 30 km × 10 km) the species appears to be relatively common and occurs in two National Parks (Tathra and Alexander Morrison).

Etymology. From the Latin *fasciculus*, a bundle, and *flos*, a flower, in reference to the flowers borne amongst distinctive leaf-fascicles.

Notes. The growth form of this species, with all leaves restricted to dense, fasciculate clusters (through the contraction of distal internodes) terminating seasonal growth units and from which the long flowering peduncles and next season's shoots arise, is distinctive. The peduncles are slender, glabrous and often somewhat curved, and persist on older shoots after the flowers have fallen.

Hibbertia fasciculiflora appears very closely related to *H. propinqua*, from which it differs in its glabrous stems and peduncles, more distinctly fasciculate leaves and flowers, and densely stellate-pubescent abaxial leaf surfaces.

Figure 3. Holotype of *Hibbertia fasciculiflora*. Scale bar = 5 cm.

Morphologically, *H. fasciculiflora* and *H. propinqua* appear closest to *H. diamesogenos* (Steud.) J.R.Wheeler and *H. hypericoides* (DC.) Benth., but these species have scattered leaves and flowers rather than distinctively fasciculate ones.

Hibbertia propinqua K.R. Thiele, *sp. nov.*

Hibbertiae fasciculiflorae affinis sed caulis juvenalis et pedunculis pubescentiis, pagina abaxiali foliorum sparse simplicipilosa differt.

Typus: Hi Vallee property (D. & J. Williams), Warradarge, *c.* one third of way along track east side of main valley, Western Australia, 30° 06' 19" S, 115° 24' 02" E, 25 August 2002, *M. Hislop* 2737 (*holo*: PERTH 06316727; *iso*: AD, MEL).

Hibbertia sp. Tathra (M.A. Langley & J.M. Harvey 1873), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed October 2009], *p.p.*

Hibbertia sp. South Eneabba (M. Hislop 2737), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed October 2009].

Erect to spreading *shrubs* to 50 cm high, single-stemmed at base, with papery bark exfoliating in flakes; young stems angular-winged below the leaf insertions, tuberculate, pubescent with minute (*c.* 0.1 mm long), white, tubercle-based stellate hairs overlain by longer (0.4–1.5 mm long), white, spreading, crisped, tubercle-based simple hairs (the latter absent on some plants), the hairs denser in the leaf axils; older stems with persistent, sparse indumentum to glabrescent. *Leaves* spreading, scattered along growth units and more crowded in fascicles at the ends of growth units, indistinctly petiolate, green, linear to narrowly oblong, 12–20 mm long, (1.0–)1.6–2.0(–2.5) mm wide; adaxial surface coarsely tuberculate, with spreading, hook-tipped to straight hairs arising from the tubercles, sometimes with few, minute, stellate hairs especially towards the base; abaxial surface with sparse, crisped, simple hairs overlying sparse, minute stellate hairs (the surface clearly visible), especially on and near the midrib; margins ± flat to recurved, often becoming revolute on drying and obscuring the abaxial leaf surface; base slightly expanded; apex recurved- (rarely straight-) apiculate, non-pungent. *Flowers* mostly borne amongst leaf-fascicles, pedunculate, the peduncles 8–16 mm long, pubescent to pilose with indumentum as for the stems; *primary bract* borne immediately below the flower, ± scarious, narrowly ovate, 4.0–5.5 mm long, 0.5–0.8 mm broad, acute, pilose adaxially and abaxially with spreading, simple hairs; *accessory bracts* 4–8, similar in size, shape and indumentum to the primary bract, usually borne at the base of the peduncle amongst the leaf whorls (rarely also midway along the peduncle). *Sepals* 5; outer sepals ovate, attenuate, 5.0–6.5 mm long, firm-textured, densely pilose outside with long, spreading, simple, white, tubercle-based hairs, pubescent inside in the upper half; midrib prominent; inner sepals broader and shorter than the outer ones, less hairy and with a broad, ± glabrous, scarious margin. *Petals* 5, yellow, obovate, 8–12 mm long, emarginate. *Fertile stamens* 8–10, all on one side of the carpels; filaments, *c.* 1 mm long; anthers obloid, 1.5–2.0 mm long, dehiscing by short, longitudinal slits at the apex; staminodes present, usually 1–2 each side of the fertile stamens. *Carpels* 2, globular, densely pubescent; styles lateral, curved, *c.* 1.5 mm long. *Ovules* 2 per carpel. *Fruiting carpels* not seen. (Figure 4)

Other specimens examined (all PERTH). WESTERN AUSTRALIA: Rocky Springs Reserve, 10 km S of Eneabba, 6 Sep. 1979, *E.A. Griffin* 2155; Mount Benia, E of Jurien; 16 Sep. 1979. *E.A. Griffin* 2253; Hi Vallee property (D. & J. Williams) Warradarge, below E breakaway, main valley, 13 Sep.

Figure 4. Holotype of *Hibbertia propinqua*. Scale bar = 5 cm.

1999, *M. Hislop* 1536; Hi Vallee property (D. & J. Williams), Warradarge, *c.* one third of way along track E side of main valley, 25 Aug. 2002, *M. Hislop* 2737; E side of the Brand Highway, 3.7 km S of junction with Rock Springs Road and *c.* 13.5 km S of Eneabba, 10 Sep. 1999, *J.W. Horn* 2377.

Distribution. Occurs between Eneabba and Mount Benia in the Geraldton Sandplains IBRA Bioregion (Department of the Environment, Water, Heritage and the Arts 2008). *Hibbertia propinqua* is closely parapatric to *H. fasciculiflora*, occurring immediately to the west of that species (Figure 2).

Habitat. Recorded from low, open *Eucalyptus* and *Banksia* woodlands and heath (kwongan), in pale grey to yellow sand and sandy loams, usually over laterite or close to laterite breakaways.

Phenology. All flowering specimens have been collected in August and September.

Conservation status. Hibbertia propinqua is listed as Priority Four under Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora (Atkins 2008) due to its restricted distribution (range *c.* 40 km x 15 km). However, it appears to be locally common; it is known to occur in South Eneabba Nature Reserve and has been collected close to Coomallo Nature Reserve, where it probably also occurs.

Etymology. From the Latin *propinquus* (near, neighbouring), in allusion to the morphological and geographic proximity of this species to the related *H. fasciculiflora.*

Notes. Hibbertia propinqua was previously included within the circumscription of *H.* sp. Tathra (M.A. Langley & J.M. Harvey 1873) along with *H. fasciculiflora*, and was only recognised as distinct during close examination for the preparation of this paper. It differs from *H. fasciculiflora* in having a less distinctively fasciculate-leaved habit with fewer flowers arising from each leaf-fascicle, pubescent young stems and peduncles, more prominently tuberculate leaves and sparsely simple-hairy abaxial leaf surfaces.

Morphologically, *H. fasciculiflora* and *H. propinqua* appear closest to *H. diamesogenos* and *H. hypericoides*, but these species have clearly scattered leaves and flowers rather than fasciculate ones.

Key to taxa

The key to Western Australian taxa of *Hibbertia* in Wheeler (2004c) should be amended as follows:

Hibbertia sp. Warradarge (couplet 106) should be replaced with *H. leucocrossa*. Couplet 28 should be replaced as follows:

28. Flower stalks single

29. Carpels 2-ovulate. Staminodes often present, 2 or 3 each side of the fertile stamens. Sepals glabrous or with simple, straight or uncinate hairs

30. Sepals glabrous or with a few appressed hairs. Bract below flower ovate to broadly ovate ..... **H. avonensis**

30. Sepals with uncinate and straight hairs. Bract below flower linear..... **H. diamesogenos**

29. Carpels 4-ovulate. Staminodes absent. Sepals with uncinate and stellate hairs ..... **H. ancistrotricha**

28. Flower stalks clustered arising from a cluster of leaves

28a. Young stems and peduncles +/- glabrous. Leaf abaxial surface (when visible) densely stellate-pubescent..... **H. fasciculiflora**

28a. Young stems and peduncles pubescent. Leaf abaxial surface (when visible) sparsely simple-pubescent over sparse, minute, stellate hairs ..... **H. propinqua**

Acknowledgements

Judy Wheeler first recognised and delimited two of the three taxa recognised in this paper in the collections of the Western Australian Herbarium, and I thank her and Mike Hislop for helpful discussions on these taxa. A duplicate of the type collection of *Hibbertia propinqua* was held in the private herbarium of Don and Joy Williams at Hi Vallee near Badgingarra, and I thank them for making this specimen available to add to the distributed type material. Kelly Shepherd provided valuable comments on the manuscript.

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A new, rare *Marianthus* (Pittosporaceae) from the Bremer Range in Western Australia

Juliet A. Wege[1] and Neil Gibson[2]

[1] Western Australian Herbarium, Department of Environment & Conservation, Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
[2] Wildlife Research Centre, Department of Environment & Conservation, PO Box 51, Wanneroo, Western Australia 6065

Abstract

Wege, J.A. & Gibson, N. A new, rare *Marianthus* (Pittosporaceae) from the Bremer Range in Western Australia. *Nuytsia* 19(2): 295–302 (2009). *Marianthus aquilonaris* N.Gibson & Wege, a new species allied to *M. mollis* (E.M.Benn.) L.Cayzer & Crisp, is described. Morphometric analysis shows that it is most readily differentiated from *M. mollis* by its higher leaf L:W ratio, higher petal L:W ratio and longer petioles. Other distinguishing features include a more erect habit, smooth and more or less glabrous leaves with attenuate rather than rounded bases, fewer pilose hairs on the stems, peduncles and fruit, and paler petals. Descriptions of both taxa are provided and include the first record of glandular trichomes for the genus. *Marianthus aquilonaris* is endemic to the Bremer Range and potentially threatened by mining-related activities. It is gazetted as Declared Rare Flora in Western Australia under the name *M.* sp. Bremer (N. Gibson & M. Lyons 1776).

Introduction

Marianthus mollis (E.M.Benn.) L.Cayzer & Crisp (Pittosporaceae) is a rare species distinctive in the genus for its shrubby habit, indumentum of pilose and glandular hairs on the stems, leaves, peduncles, calyces and fruit, and blue to purple flowers on ± nodding peduncles. Originally named under the genus *Billardiera* Sm. from a population in the Ravensthorpe Range (Bennett 1983), it was transferred to *Marianthus* Hueg. ex Endl. by Cayzer and Crisp (2004) who reinstated this genus on the basis of both morphological and molecular data. In addition to populations from the Ravensthorpe Range, Cayzer and Crisp (2004) included a specimen from the Bremer Range (*N. Gibson & M. Lyons* 1776) under their concept of *M. mollis*. This collection had previously been considered to represent a distinct, new taxon on account of its glabrous leaves (Western Australian Herbarium 1998–, as *M.* sp. Bremer (N. Gibson & M. Lyons 1776); Gibson & Lyons 1998, as *Billardiera* sp. nov.). We reinvestigate the taxonomic distinctness of the Bremer Range population in view of the rarity of *M. mollis* and the ongoing mining and mineral exploration in both the Ravensthorpe and Bremer Ranges.

Methods

The morphometric analyses are based on 21 individuals: five from each of two subpopulations in each Range (*J.A. Wege, R. Butcher & N. Gibson* JAW 1408, 1409, 1411 and 1412), and an additional, unusually robust individual that was growing in a disturbed area beside a drainage channel (JAW 1412). The following quantitative characters were scored: leaf length (not including petiole), leaf width (at widest point), leaf length:width ratio, petiole length, penduncle length, petal length, petal width (at widest point), petal length:width ratio and pistil length. Leaf features were scored from pressed specimens whereas floral characters were measured from flowers preserved in 70% ethanol. Five leaves and five flowers were measured for each individual, with the individual petal measurements averaged for each flower.

Principal Component Analysis (PCA) was undertaken on normalised quantitative characters. Normalisation was used to remove the scale factor differences between variables. These data were also analysed using Canonical Analysis of Principal Coordinates (CAP) in order to test the level of discrimination between the two presumed taxa (Anderson & Willis 2003). This analysis was undertaken using an euclidean distance matrix based on the normalised dataset. All analyses were undertaken using PRIMER 6 software package (Clarke & Gorley 2006).

Qualitative characters and additional quantitative data were coded from the aforementioned vouchers along with the remaining collections housed at the Western Australian Herbarium (PERTH). Habit, flower colour and habitat data were compiled from field observations, herbarium label information and existing photographic records. Trichomes preserved in 70% ethanol were mounted on a glass slide in Apathy's Aqueous Mountant and viewed under a compound microscope to ascertain their structure.

Results and discussion

Trichome morphology. Marianthus mollis s. str. and the Bremer Range individuals share an indumentum that consists of pilose hairs to 2 mm long and shorter, glandular trichomes 0.1–0.3 mm long. The pilose hairs are uniseriate and consist of 3–5 basal cells topped by an elongated, terminal cell. The terminal cell can fall off, leaving the basal cell as a short protuberance. The glandular hairs comprise a short, uniseriate and multicellular stalk with a terminal, ellipsoid to obloid head. Some of the hairs appear to lack the terminal cell although it is unclear whether this is a earlier developmental stage or a third distinct trichome type. Glandular hairs have hitherto been unrecorded for *Marianthus*. We have also observed them on the peduncles of *M. granulatus* (Turcz.) Benth., inconspicuous beneath a dense indumentum of pilose hairs.

Data analysis. The results of the PCA of the quantitative data are consistent with the recognition of two distinct taxa, with the first three axes accounting for 84.9% of the variation (Figure 1). The collections from the Bremer Range were most easily separated from *M. mollis s. str.* by their higher leaf L:W ratio, higher petal L:W ratio, and longer petioles. The multivariate discriminant analysis (results not shown) also supported the recognition of two taxa along one discriminant axis (canonical correlation = 0.90). Diagnostic tests indicate best discrimination was derived from the first three principal coordinates representing 84.9 % variation in the distance matrix, this achieved 0% misclassification error using 'leave-one-out' procedures (Anderson & Willis 2003). An additional CAP showed no evidence of significant population level differences for the quantitative characters.

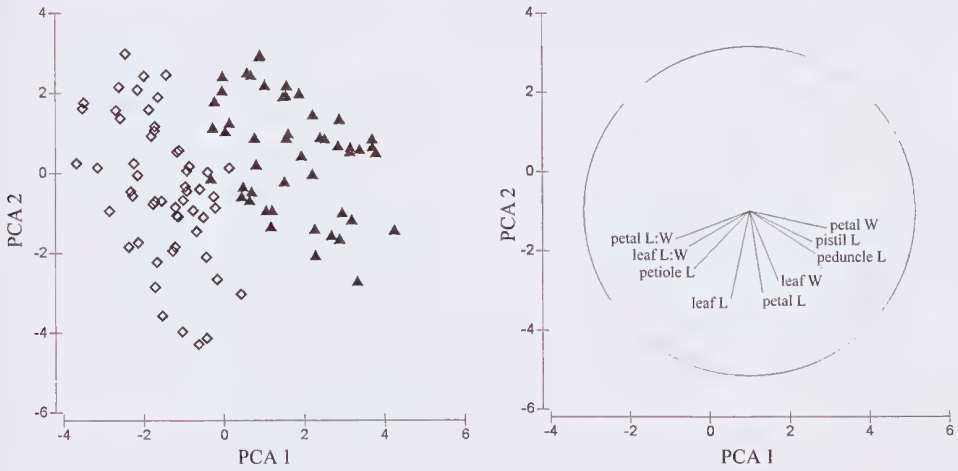

Figure 1. Plot of PCA of five replicates for each five individuals from two populations in the Ravensthorpe Range (▲) and five replicates for five and six individuals from two populations in the Bremer Range (◊). PCA 1 accounted for 36.5% and PCA 2 for 30.0% of the total variation. Eigenvectors are represented in graphical form on the right and show the direction of main contribution of each variable.

There are several qualitative characters that independently support the recognition of two taxa. The Bremer Range individuals tend to have a taller, more erect growth form (Figure 2A) as compared to the lower, more spreading habit of *M. mollis s. str.* (Figure 2E) and they also possess attenuate (Figure 2B) rather than rounded leaf bases (Figure 2F). The leaves of the Bremer Range individuals are also glabrous on both surfaces, even in the juvenile state, although a sparse indumentum of both glandular and pilose hairs may be present on the margin of the young leaves. These hairs are lost with age through abrasion, although the hair bases remain as small papillate protuberances. The conspicuous hairs on the leaves of *M. mollis s. str.* are similarly lost over time and therefore mature leaves can have a papillate surface, in contrast to the smooth leaf surface found in the Bremer Range individuals. Plants from the Bremer Range also have noticeably fewer pilose hairs on their stems, peduncles and fruit. On the basis of our field observations and the notes and photographs of other collectors, there appears to be a difference in flower colour, with plants from the Bremer Range possessing pale blue to almost white petals and *M. mollis s. str.* darker blue-purple petals. We are uncertain how flower colour varies within and between populations of the same species, or with the age of the flower.

The congruence of differences in quantitative and qualitative characters between the Bremer Range and Ravensthorpe Range plants clearly supports the recognition of two taxa.

Taxonomy

Marianthus aquilonaris N.Gibson & Wege, *sp. nov.*

A *Mariantho molli* habitu erecta, foliis ± glabris et longitudine:latitudine 2.1–4.1, floribus pallidis differt.

Typus: Bremer Range, Western Australia [precise locality withheld for conservation purposes], 15 September 1994, *N. Gibson & M. Lyons* 1776 (*holo*: PERTH 4122208; *iso*: CANB).

Marianthus sp. Bremer (N. Gibson & M. Lyons 1776), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au [accessed 12 February 2009].

Billardiera sp. nov. (NG & ML 1776), in Gibson & Lyons, *J. Roy. Soc. W.A.* 81(2): 117 (1998).

Upright, multi-stemmed *shrub*, 0.3–1.6 m high, 0.15–1 m wide; *stems* with a dense indumentum of ± glandular hairs to 0.2 mm long and scattered pilose hairs 0.5–2 mm long, becoming glabrous with age through abrasion. *Adult leaves* alternate, elliptic to oblong, flat in T.S., 7–22(–25) mm long and 2.3–7(–9) mm wide with a L:W ratio of 2.1–4.1, apex acuminate to acute, margins entire, base attenuate with a petiole 1–2.5 mm long, yellow-green usually with a reddish border, glabrous with the exception of sparse pilose and shorter, ± glandular hairs on the margins of young leaves, margins becoming minutely papillose with age through abrasion. *Inflorescences* axillary, flowers solitary, ± nodding; peduncles suberect to spreading, 3–12(–19) mm long, with a dense covering of ± glandular hairs to 0.2 mm long and very sparse pilose hairs. *Sepals* 3–7 mm long, acute, pilose and glandular. *Petals* 5, cohering at the base then recurving, spathulate, 11–19.5 mm long and 2–4.3 mm wide with a L:W ratio of 3.3–7.1, apex acuminate, margins entire, pale blue to almost white with fine purple striations at anthesis, pilose along central upper surface. *Stamens* 5; filaments 5–9.5 mm long, flared towards the base; anthers dorsifixed, white. *Pistil* 4.5–7.5 mm long; ovary bilocular, with a medium dense indumentum of pilose hairs and shorter, ± glandular hairs; style curved or straight, hairy towards base. *Fruit* capsular, obloid to ellipsoid, 7.5–12 mm long, 6–8 mm wide, with sparse to medium pilose and glandular hairs. *Seeds* broadly elliptic to reniform, *c.* 1.5–1.6 mm long, 1.4 mm wide, dark red-brown, shiny, wrinkled, arillate. (Figure 2A–C)

Specimens examined. WESTERN AUSTRALIA: [localities withheld] 18 Sep. 2002, *R. Butler* 299-01 (PERTH); 18 Sep. 2002, *R. Butler* 299-02 (PERTH); 14 Dec. 2004, *J.A. Cochrane & R. Butler* JAC 5266 (PERTH); 14 Dec. 2004, *J.A. Cochrane & R. Butler* JAC 5268 (PERTH); 14 Dec. 2004, *J.A. Cochrane & R. Butler* JAC 5270 (PERTH); 25 May 2004, *G.F. Craig* 6101 (PERTH); 11 Oct. 2003, *G.F. Craig* 5900 (PERTH); 7 Oct. 2008, *J.A. Wege, R. Butcher & N. Gibson* 1411 (CANB, MEL, PERTH); 7 Oct. 2008, *J.A. Wege, R. Butcher & N. Gibson* 1412 (CANB, MEL, PERTH).

Distribution and habitat. Restricted to the Bremer Range in the Coolgardie bioregion of southern Western Australia (Figure 3). Grows on weathered hill slopes and hill tops in skeletal sandy-loam over sheet laterite in open *Eucalyptus livida* woodland over low shrubs.

Flowering and fruiting period. Flowering specimens have been collected in September and October, and fruiting material in October and December.

Conservation status. Listed as Declared Rare Flora under the Western Australian *Wildlife Conservation Act 1950*, under the name *M.* sp. Bremer (N. Gibson & M. Lyons 1776). This species is locally common but highly restricted in distribution. No land in the Bremer Range is currently allocated to the conservation estate and vegetation in the region has been significantly impacted by mining and mineral exploration (Gibson & Lyons 1998).

Etymology. The species epithet is Latin for 'northern' and refers to the geographic location of this taxon in relation to the morphologically allied *M. mollis*. It is also an obscure reference to the failed

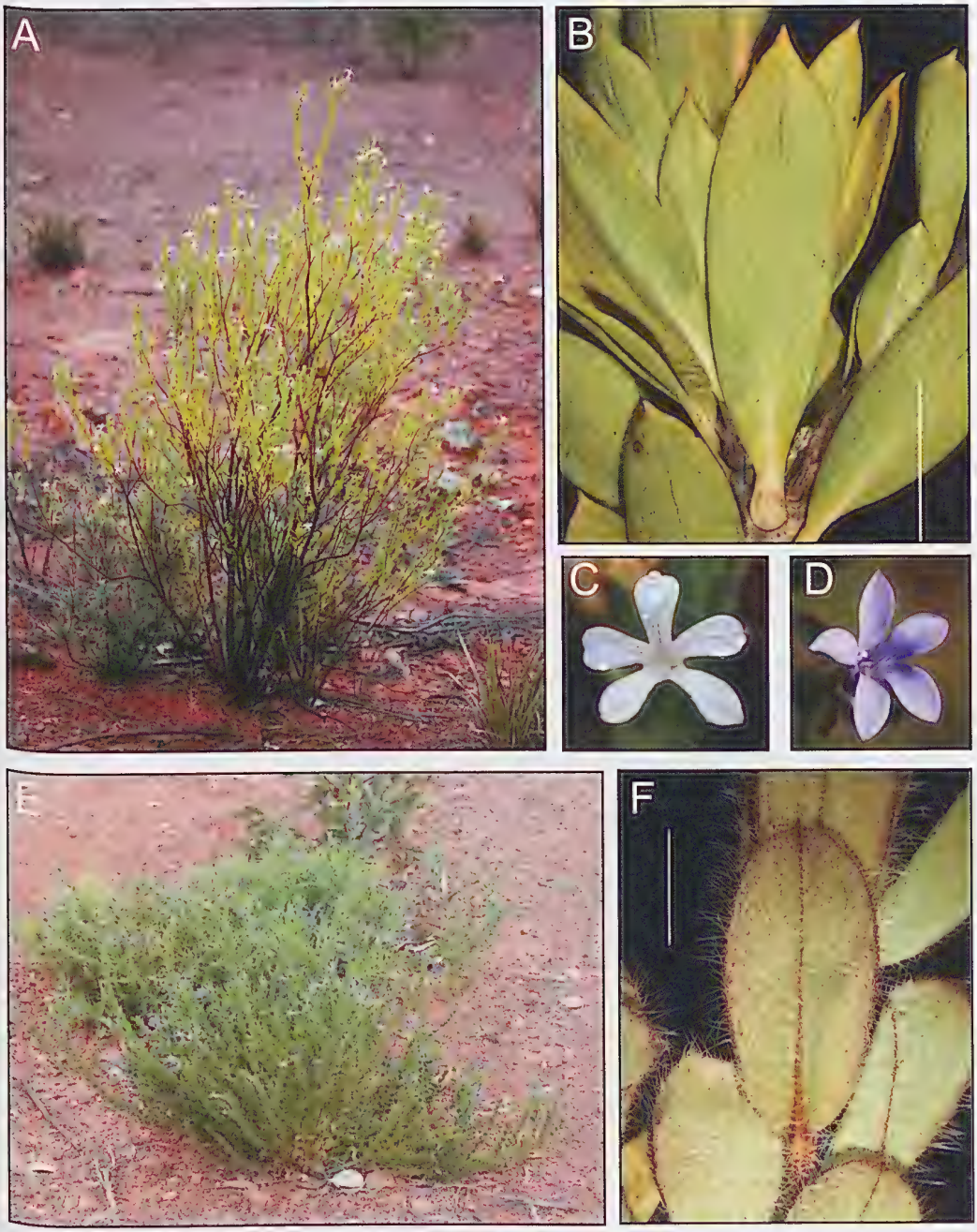

Figure 2. A–C. *Marianthus aquilonaris* (*J.A. Wege, R. Butcher & N. Gibson* JAW 1411) A – habit; B – young leaves, scale at 5 mm; C – flower; D–F. *M. mollis* (*J.A. Wege, R. Butcher & N. Gibson* JAW 1408) D – flower; E – habit; F – young leaves, scale at 5 mm.

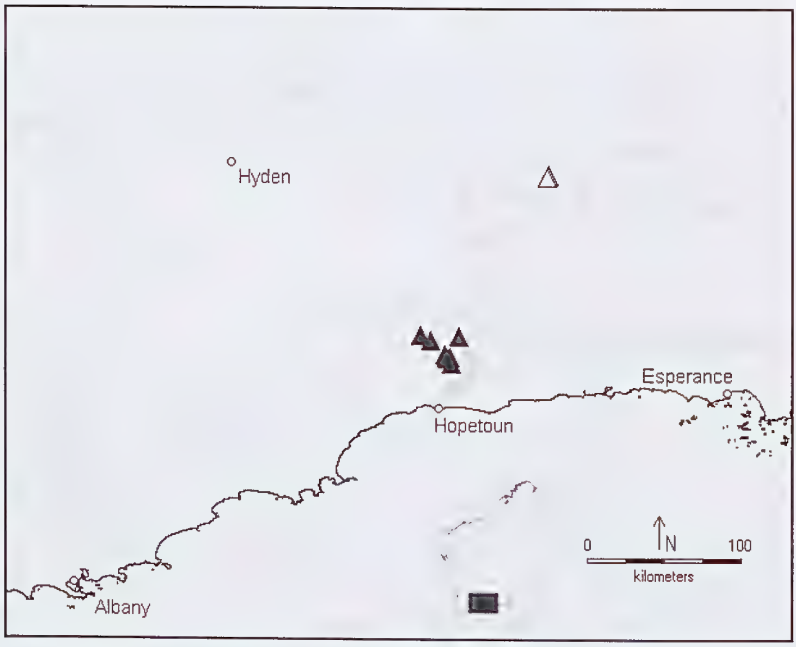

Figure 3. Distribution of *Marianthus aquilonaris* (△) and *M. mollis* (▲) in south-west Western Australia, with Version 6.1 IBRA regions (Department of Environment and Water Resources 2007) indicated in grey.

settlement attempt at Fort Dundas on Melville Island on the northern coast of Australia, led by Captain James J. Gordon Bremer on the *Tamar*. John Septimus Roe was a lieutenant on board the *Tamar* and, when he later became first surveyor-general in Western Australia, he commemorated this settlement attempt in several topographic features, including the Bremer Range, Mt Gordon and Tamar Hill.

Diagnostic features. An erect, shrubby habit; an indumentum of pilose hairs to 2 mm long and shorter, ± glandular hairs to 0.3 mm long; smooth, elliptic to oblong leaves (L:W ratio 2.1–4.1) with attenuate bases and petioles 1–2.5 mm long; pale blue to white petals with a L:W ratio of 3.3–7.1; hairy fruiting capsules.

Marianthus mollis (E.M.Benn.) L.Cayzer & Crisp, *Aust. Syst. Bot.* 17(1): 138 (2004). *Billardiera mollis* E.M.Benn., *Nuytsia* 4(3): 275 (1983). *Type*: Ravensthorpe Range [precise locality withheld for conservation purposes], Western Australia, 16 September 1979, *E.M. Bennett* 16,979 (*holo*: PERTH 1174142!; *iso*: CANB, K, MEL).

Low, multi-stemmed, spreading *shrub* 0.2–0.6(–1) m high and 0.2–0.8 m wide; *stems* with a dense indumentum of ± glandular hairs to 0.3 mm long and pilose hairs 0.5–2 mm long, becoming glabrous with age through abrasion. *Adult leaves* alternate, ovate to oblong, flat in T.S., 6–25 mm long and 3.2–10.5 mm wide with a L:W ratio of 0.9–2.8, apex acuminate, more rarely acute, margins entire, base rounded with a petiole 0.5–1.5 mm long, dull medium green usually with a reddish border, with pilose and inconspicuous glandular hairs on both surfaces and the margin, becoming papillose with age through abrasion. *Inflorescences* axillary, flowers solitary, ± nodding; peduncles spreading, 8–30 mm long, with a dense covering of ± glandular hairs to 0.3 mm long and longer pilose hairs scattered evenly throughout. *Sepals* 3–8 mm long, acute, pilose and glandular. *Petals* 5, cohering at the base then recurving, spathulate, 10.5–18 mm long and 2.4–5.5 mm wide with a L:W ratio of 2.5–5.2,

apex acuminate, margins entire, dark purple-blue, white towards base, with fine purple striations at anthesis, pilose along the central upper surface. *Stamens* 5; filaments 5.5–9.8 mm long, flared towards the base; anthers dorsifixed, white. *Pistil* 5.7–7.8 mm long; ovary bilocular, with a dense indumentum of pilose hairs obscuring shorter, ± glandular hairs; style curved or straight, hairy towards base. *Fruit* capsular, ellipsoid to oblong, occasionally obovate, 6.5–10 mm long, 5–7 mm wide, with dense pilose and glandular hairs. *Seeds* elliptic to reniform, 1.6–2 mm long, 1.5–1.8 mm wide, dark red-brown, shiny, wrinkled, arillate. (Figure 2D–F)

Specimens examined. WESTERN AUSTRALIA: [localities withheld] 16 Oct. 2007, *E.D. Adams* 30/1007 (PERTH); 9 Sep. 1999, *S. Barrett* 793 (PERTH); 19 Dec. 2005, *B.L. Bayliss* BLB 33 (PERTH); 20 Dec. 2005, *B.L. Bayliss* BLB 39 (PERTH); 16 Nov. 1979, *E.M. Bennett s.n.* (CANB, PERTH); Sep. 1980, *E.M. Bennett s.n.* (PERTH); 7 Dec. 1995, *J.A. Cochrane* JAC 1801 (PERTH); 13 Dec. 2004, *J.A. Cochrane & K. Bennett* JAC 5245 (PERTH); 7 Dec. 2003, *G.F. Craig* 6000 (PERTH); 6 Feb. 2004, *G.F. Craig* 6044 (PERTH); 8 May 2007, *G.F. Craig* 8231 (PERTH); 2 Dec. 1998, *J. Hill* 2 (PERTH); 4 Sep. 2007, *S. Kern, R. Jasper & H. Hughes* LCH 17302 (PERTH); 25 Sep. 2007, *S. Kern, R. Jasper & H. Hughes* LCH 17611 (PERTH); 25 Sep. 2007, *S. Kern, R. Jasper & H. Hughes* LCH 17613 (PERTH); 27 Sep. 2007, *S. Kern, R. Jasper & H. Hughes* LCH 17780 (PERTH); 25 Oct. 1987, *K.R. Newbey* 11803 (PERTH); 6 Oct. 2008, *J.A. Wege, R. Butcher & N. Gibson* JAW 1408 (CANB, MEL, PERTH); 6 Oct. 2008, *J.A. Wege, R. Butcher & N. Gibson* JAW 1409 (CANB, MEL, PERTH).

Distribution and habitat. Largely restricted to the Ravensthorpe Range in the Esperance bioregion of southern Western Australia, with a single record from *c.* 20 km north-east of Ravensthorpe (Figure 3). Found on ridge crests and upper hill slopes in sandy loam, clay loam or light clay over laterite, with surface fragments of laterite, schist and silcrete, shale or siltstone. Grows in tall mallee shrubland and open mallee shrubland over dense heath, often in association with *Banksia lemanniana*. Also recorded in tall shrubland of *Acacia pinguiculosa* subsp. *pinguiculosa* and *Kunzea affinis* over *Lepidosperma*.

Flowering and fruiting period. Flowering from early September to December, with a single record from February (*G.F. Craig* 6044). Mature fruit has been collected in November, December and February.

Conservation status. Gazetted as Declared Rare Flora under the Western Australian *Wildlife Conservation Act 1950*.

Diagnostic features. A low, spreading habit; a dense indumentum of pilose hairs to 2 mm long and shorter ± glandular hairs to 0.3 mm long; pilose or minutely papillate, ovate to oblong leaves (L:W ratio 0.9–2.8) with rounded bases and petioles to 1.5 mm long; dark blue-purple petals with a L:W ratio of 2.5–5.2; hairy fruiting capsules.

An amendment to the *Key to Marianthus* (Cayzer & Crisp 2004: 129)

3. Erect to spreading shrubs, not scandent; petals purple, blue or almost white

4. Branching shrubs 0.2–1.6 m high; new shoots with both pilose and glandular hairs; leaves alternate, 7–25 × 2.3–10.5, ovate, elliptic or oblong; flowers in leaf axils, ± nodding on slender peduncles 3–30 mm long; petals dark purple-blue or pale blue to almost white

4a. Leaves ovate, elliptic or oblong (L:W 0.9–2.8), rounded at base with petioles to 1.5 mm, bearing pilose and glandular hairs on both surfaces (becoming papillate through abrasion); petals dark purple-blue ..... **(10) M. mollis**

4b. Leaves elliptic to oblong (L:W ratio 2.1–4.1), attenuate at base with petioles 1–2.5 mm long, glabrous on both surfaces; petals pale blue to lmost white ..... **M. aquilonaris**

Acknowledgements

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Two new species of *Hibbertia* (Dilleniaceae) from near Ravensthorpe in Western Australia

Juliet A. Wege & Kevin R. Thiele

Western Australian Herbarium, Department of Environment & Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983

Abstract

Wege, J.A. & Thiele, K.R. Two new species of *Hibbertia* (Dilleniaceae) from near Ravensthorpe in Western Australia. *Nuytsia* 19(2): 303–310 (2009). Two new and geographically restricted species allied to *Hibbertia hamulosa* J.R.Wheeler and *H. mucronata* (Turcz.) Benth. are newly described. *Hibbertia abyssa* Wege & K.R.Thiele is distinctive for its long, slender and more or less glabrous peduncles, and sepals with both uncinate and minute stellate hairs on the outer surface. This species, which occurs on shallow soils with siltstone outcropping, is known from a single population adjacent to the nickel mine on Bandalup Hill and has recently been nominated for listing as Declared Rare Flora. *Hibbertia atrichosepala* Wege & K.R.Thiele is readily distinguished from allied species by its completely glabrous sepals. It is a narrow-range endemic of rocky, lateritic habitats in the Ravensthorpe Range and is listed as having Priority One conservation status.

Introduction

Recent floristic surveys and inventories of the Ravensthorpe Range and Bandalup Hill in southern Western Australia have resulted in the discovery and subsequent description of a number of new and geographically restricted species (e.g. Nicolle 2002; Orthia *et al.* 2005; Rye 2006; Barrett 2007; Toelken & Craig 2007; Wege 2007; Wilkins *et al.* 2009), with a number of additional taxa awaiting formal description (Western Australian Herbarium 1998–). This region is a biologically important area of south-west Western Australia, supporting a wide variety of habitat types and a species-rich flora with significant levels of endemism (Beard 1973; Craig 1995; Craig *et al.* 2007; Kern *et al.* 2008). Despite this, little land in this region is allocated to the conservation estate: it is predominantly unallocated Crown Land, most of which is covered by mining tenements (Harris *et al.* 2008). The area has a varied terrain and complex geology, including greenstone and banded ironstone, and is highly prospective for minerals such as nickel, magnesite, iron, gold, copper, silver and spongolite (Beard 1973; Thom *et al.* 1977).

Surveys of the Ravensthorpe Range and Bandalup Hill in 2007 (Kern *et al.* 2008) revealed two new species of *Hibbertia* Andrews (Dilleniaceae) from the *H. mucronata* (Turcz.) Benth. species complex. This small species complex, recently revised by Wheeler (2000), also includes *H. axillibarba* J.R.Wheeler, *H. carinata* J.R.Wheeler, *H. charlesii* J.R.Wheeler, *H. hamulosa* J.R.Wheeler, *H. stowardii* S.Moore and *H. ulicifolia* (Benth.) J.R.Wheeler. Species in the complex are characterised by their more or less linear leaves with tightly revolute margins meeting or covering a prominent abaxial midrib and

straight, strongly pungent apices, outer sepals with acuminate or hardened, pungent apices, and flowers with less than 12 stamens arranged on one side of the two hairy carpels. Staminodes are absent except in *H. charlesii* which has 5–10 staminodes arranged on both sides of the stamens.

Both new species are narrow-range endemics and are potentially threatened by mining-related activities. Their recognition highlights not only the importance of ongoing floristic survey to biodiversity conservation in Western Australia, but of subsequent taxonomic study of anomalous collections.

Methods

This study is based upon the examination of specimens at the Western Australian Herbarium (PERTH) and supplementary field photographs. Precise locality statements have been withheld in view of the rarity of these species.

Taxonomy

Hibbertia abyssa Wege & K.R.Thiele, *sp. nov.*

Ex *Hibbertiae hamulosae* foliis effusis et pedunculi longioribus et glabrae differt.

Typus: Bandalup Hill, Western Australia [precise locality withheld for conservation reasons] 6 November 2008, *A. Markey & J. Allen* 6216 (*holo*: PERTH 08021937; *iso*: AD, CANB, HO, K, MEL, NSW).

Hibbertia sp. Bandalup Hill (G.F. Craig 3479), Western Australian Herbarium, in *FloraBase*, http://www.florabase.dec.wa.gov.au [accessed 4 March 2009].

Upright, single- or multi-stemmed *shrub* to 1.2 m high with sprawling lower stems; young branchlets distinctly ribbed from the base of each petiole, densely stellate-hairy between the ± glabrous ribs. *Leaves* spirally arranged, crowded, ascending when young, spreading to slightly more than 90° to the stem; petioles 0.5–1 mm long, with a dense indumentum of simple and/or stellate hairs on the adaxial surface and margin, glabrous abaxially; lamina linear to subulate, (4–)6–11(–14) mm long, 0.9–1.4(–1.6) mm wide, subterete, with the margin tightly recurved to a prominent, thickened midrib; upper surface with sparse tubercles, occasionally with very sparse, antrorse simple and/or stellate hairs; apex a strong, straight, pungent mucro. *Flowers* solitary in the axils; peduncles ascending, straight or sigmoidally curved, 6–14 mm long, glabrous or with sparse uncinate hairs distally; bract subtending the flower narrowly triangular, 1.5–2 mm long, acute to acuminate with ciliolate margins. *Sepals* 5, green with dark red markings, elliptic to narrowly ovate, 3.5–5 mm long; outer sepals with a short, indurate, pungent apex, outer surface with moderately dense uncinate hairs and sparse minute stellate hairs, inner surface with minute stellate hairs apically; inner sepals obtuse, outer surface with sparse uncinate and stellate hairs, the margins membraneous and glabrous, inner surface glabrous. *Petals* 5, yellow, obovate, 6–8.5 mm long, emarginate. Stamens 5, all on one side of the carpels, connate basally; filaments *c.* 0.5 mm long; anthers narrowly ovate to oblong, 2–2.2 mm long, dehiscing by longitudinal slits; staminodes absent. *Carpels* 2, broadly ellipsoid, densely hairy; ovules 2 per carpel. *Fruiting carpels* not seen. (Figure 1)

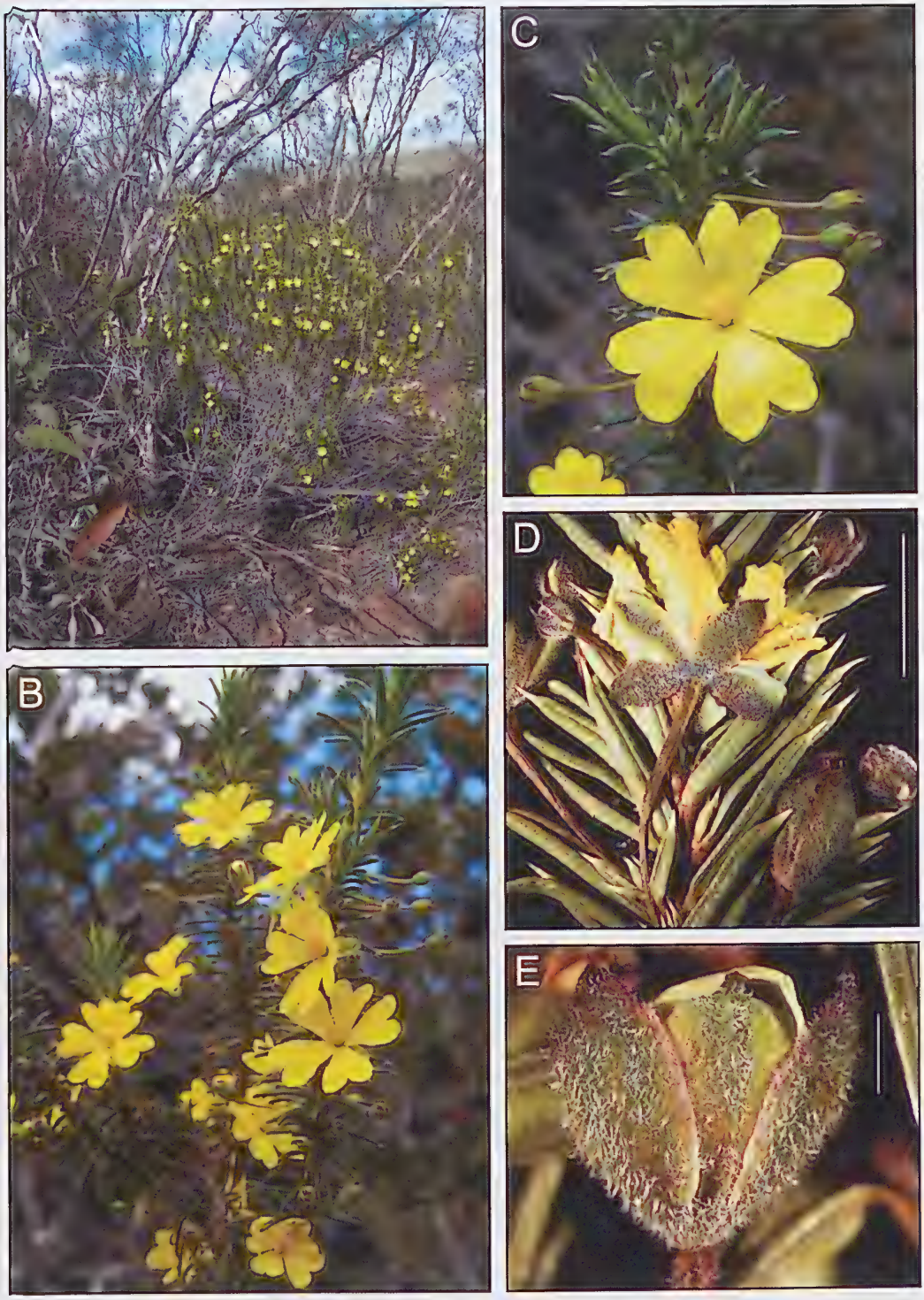

Figure 1. *Hibbertia abyssa* (*A. Markey & J. Allen* 6216). A – habit; B – stem portion showing ascending young leaves, spreading mature leaves and axillary flowers on long peduncles; C – flower, with stamens arranged on one side of the carpels; D – portion of herbarium specimen showing the pungent leaves and long ± glabrous peduncles, scale 5 mm; E – bud, showing the uncinate-hairy sepals, scale 1 mm. Field photographs (A–C) by Adrienne Markey.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons], 16 Feb. 1998, *G.F. Craig* 3479 (PERTH); 9 Oct. 2007, *S. Kern & R. Jasper* RR 2211 (PERTH); 6 Nov. 2008, *A. Markey & J. Allen* 6217 (AD, CANB, PERTH).

Distribution and habitat. Known only from Bandalup Hill, east of Ravensthorpe and the Jerdacuttup River on the south coast of Western Australia (Figure 2). Occurs on rocky outcrops in shallow red-brown light clay with surface siltstone fragments in *Eucalyptus pleurocarpa* and *E. lehmannii* subsp. *parallela* open mallee shrubland with *Banksia lemanniana* and *Melaleuca pentagona* var. *latifolia.*

Phenology. Flowers have been recorded in October, November and February.

Conservation status. Currently listed as Priority One under Department of Environment and Conservation (DEC) Conservation Codes for Western Australia Flora under the name *H.* sp. Bandalup Hill (G.F. Craig 3479) (Atkins 2008), although has been nominated for listing as Declared Rare Flora. *Hibbertia abyssa* is known from a single population on Bandalup Hill which is situated adjacent to the BHP Billiton nickel mine. Part of the population was cleared in 2008. The mine was subsequently closed in January 2009 as a result of an economic downturn and concomitant fall in nickel prices. Whilst mining is no longer an immediate threat to the survival of this species, it may be impacted by dieback and potentially by dust from the adjacent pit. It will again be threatened by mining if the mine reopens.

Etymology. The epithet is derived from the Latin *abyssus* (f.; an abyss, a bottomless pit) and the adjectival suffix -a (indicating place of growth), in reference to its position at the edge of a mine pit and also at the edge of extinction.

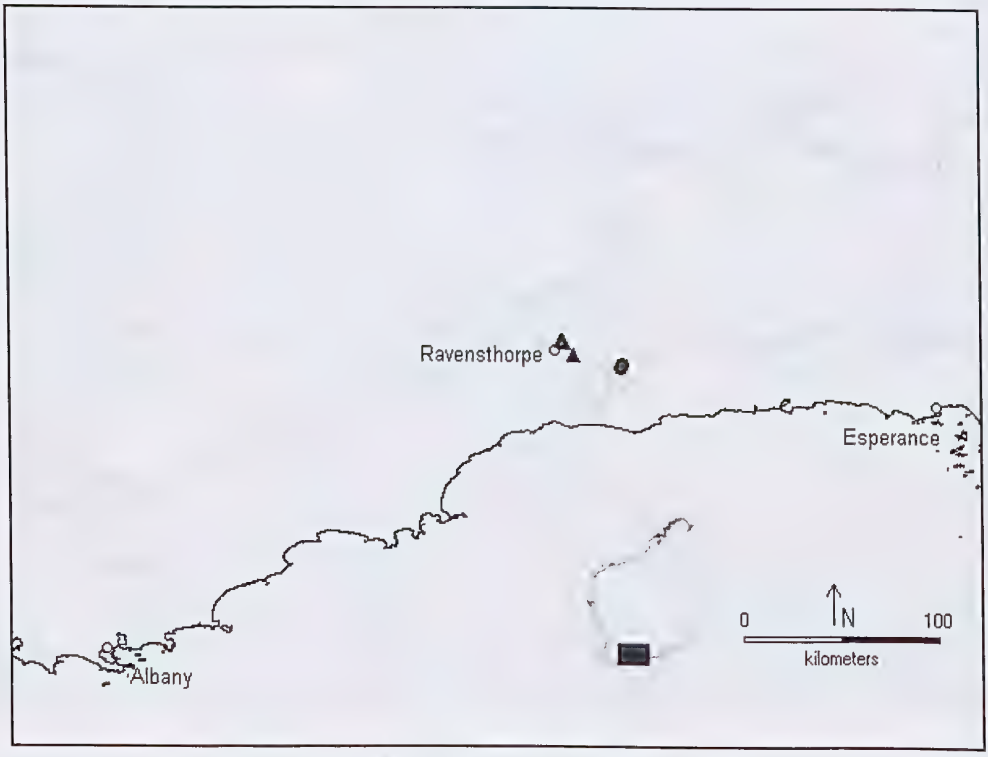

Figure 2. Distribution of *Hibbertia abyssa* (●) and *H. atrichosepala* (▲) in south-west Western Australia, with *Version 6.1 IBRA regions* (Department of the Environment, Water, Heritage and the Arts 2008) indicated in grey.

Affinities. The long, slender and more or less glabrous peduncles of *H. abyssa* differentiate it from allied taxa. The combination of uncinate and stellate hairs on the outer sepals of *H. abyssa* suggests an affinity to *H. hamulosa*, a species also known from rocky habitats, in Fitzgerald River National Park to the south-east of Bandalup Hill. This species differs most obviously from *H. abyssa* in having densely stellate-hairy rather than glabrous stem ribs, shorter (2–4 mm long) and densely stellate-hairy peduncles, and mature leaves which tend not to spread beyond 45 degrees to the stem.

Hibbertia abyssa may also be confused with *H. atrichosepala* and *H. mucronata* which are also known from the Ravensthorpe region, although neither species is recorded east of the Jerdacuttup River. *Hibbertia atrichosepala* can be readily differentiated from *H. abyssa* by its shorter penduncles (3.5–7 mm long), and glabrous sepals. It also tends to have larger petals and more prominently pungent outer sepals. Both species occur in rocky habitats, however, *H. abyssa* is restricted to skeletal soils over siltstone, whereas *H. atrichosepala* occurs on deeper loam soils over lateritic gravels. *Hibbertia mucronata* differs from *H. abyssa* in having stems, peduncles and young leaves with simple, pilose hairs, shorter penduncles (to 2 mm long), and sepals with stellate hairs and no uncinate hairs. *Hibbertia mucronata* is recorded in sand or loam over a variety of substrates including quartzite, spongolite, limestone and granite.

Like *H. abyssa*, *H. ulicifolia* has relatively long (4–8 mm) peduncles, however, they are stellate-hairy rather than more or less glabrous. *Hibbertia ulicifolia* differs further from *H. abyssa* in having nine stamens and stellate-hairy sepals. It grows in coastal granite habitats well east of Bandalup Hill.

Notes. Observations on plants growing in an area burnt in *c.* 2003 indicate that *H. abyssa* has the ability to resprout after fire (A. Markey, pers. comm.).

Hibbertia atrichosepala Wege & K.R.Thiele, *sp. nov.*

Ex *Hibbertiae mucronatae* indumento caulium juvenalium stellato-piloso, pedunculi longioribus, sepalis exterioribus glabris differt.

Typus: Ravensthorpe Range, Western Australia [precise locality withheld for conservation reasons], 10 September 2008, *R. Butcher & A. Markey* RB 1276 (*holo*: PERTH 08021945; *iso*: AD, CANB, MEL, NSW).

Hibbertia sp. Ravensthorpe Range (E. Tink 335), Western Australian Herbarium, in *FloraBase*, http://www.florabase.dec.wa.gov.au [accessed 4 March 2009].

Upright, apparently single-stemmed *shrub* to 1.2 m high with sprawling lower stems; young branchlets distinctly ribbed from the base of each petiole, densely stellate-hairy between the ± glabrous ribs. *Leaves* spirally arranged, crowded, ascending when young, spreading up to 90 degrees to the stem; petioles 0.3–1 mm long, with dense, simple hairs on the adaxial surface, glabrous abaxially; lamina linear to subulate, (4–)7–13(–15) mm long, 0.8–1.4 mm wide, subterete, with the margin tightly recurved to a prominent, thickened midrib; upper surface with sparse tubercles and ± sparse, antrorse simple hairs; apex a strong, straight, pungent mucro. *Flowers* solitary in the axils; peduncles ± straight, ascending, 3.5–7 mm long, glabrous aside from minute stellate hairs at the very base; bract subtending the flower narrowly triangular, 1.5–2.5 mm long, acute to acuminate, with simple hairs on the adaxial surface. *Sepals* 5, green ± tinged red, elliptic to ovate, 4.5–6 mm long, glabrous; outer sepals strongly acuminate and pungent; inner sepals obtuse, the margin membraneous. *Petals* 5, yellow, obovate, 8–10 mm long, emarginate. Stamens 5, all on one side of the carpels, connate

basally; filaments *c.* 0.5 mm long; anthers narrowly ovate to oblong, 2–2.5 mm long, dehiscing by longitudinal slits; staminodes absent. *Carpels* 2, ellipsoid to ovoid, densely hairy; ovules 2 per carpel. *Fruiting carpels* dry, one or two developing to maturity, subglobular, *c.* 3 mm long, 2.5 mm wide; mature seed not seen. (Figure 3)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 15 Sep. 2008, *R. Butcher & A. Markey* RB 1300 (PERTH); 18 Apr. 2007, *S. Kern, R. Jasper & D. Brassington* RR 0616 (PERTH); 2 Oct. 2007, *S. Kern, R. Jasper & H. Hughes* RR 1946 (PERTH); 21 Nov. 2008, *A. Markey & J. Allen* 6218 (AD, PERTH); 21 Nov. 2008, *A. Markey & J. Allen* 6219 (CANB, PERTH); 24 Oct. 1998, *E. Tink* 335 (PERTH).

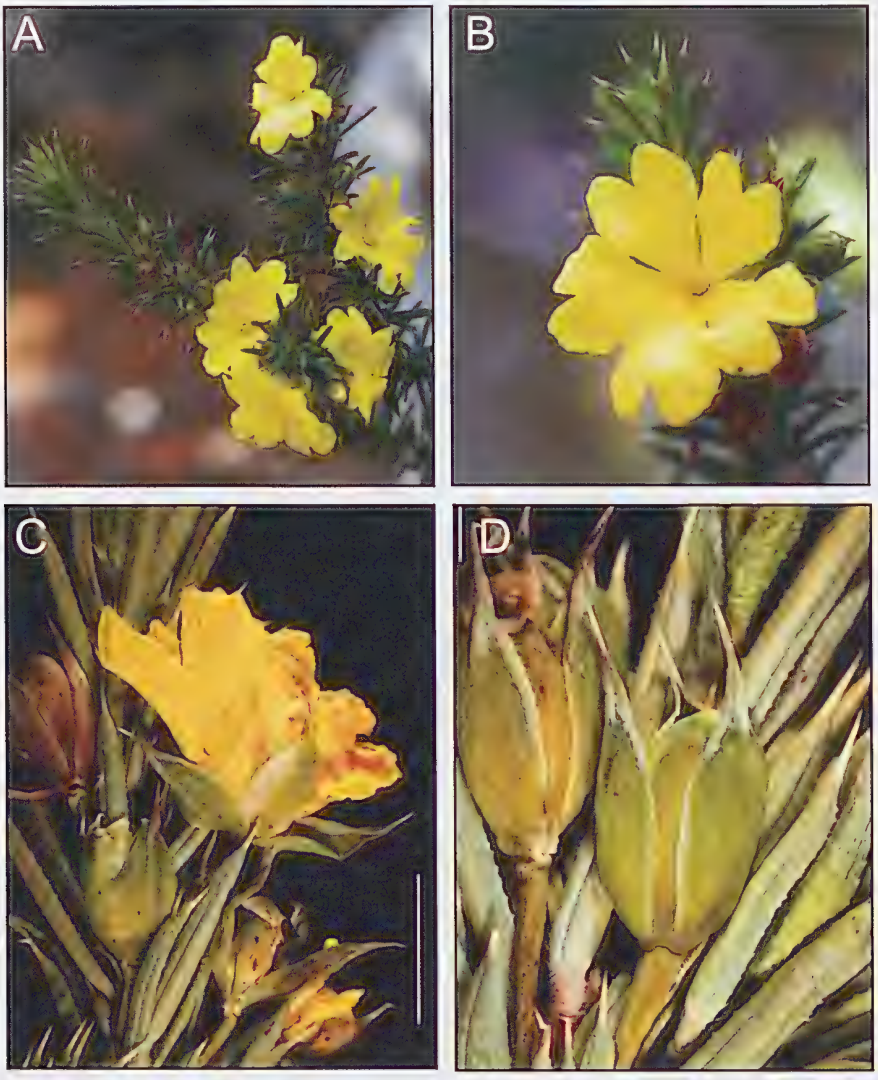

Figure 3. *Hibbertia atrichosepala* (*R. Butcher & A. Markey* RB 1276). A – stem portion; B – flower, with stamens arranged on one side of the carpels; C – portion of herbarium specimen showing the pungent leaves and glabrous sepals, scale 5 mm; D – buds, showing the moderately long peduncles and the strongly acuminate, glabrous outer sepals, scale 1 mm. Field photographs (A –B) by Ryonen Butcher.

Distribution and habitat. Known only from rocky hill slopes in the Ravensthorpe Range (Figure 2), where it grows in clay loams with laterite fragments at the surface. Recorded in *Eucalyptus falcata* subsp. *falcata* and *E. pleurocarpa* mallee woodland, *E. lehmannii* subsp. *parallela* and *E. falcata* subsp. *falcata* mallee woodland, and *Acacia* sp. Ravensthorpe (R.S. Cowan & B.R. Maslin RSC A-760), *Banksia laevigata* and *Hakea multilineata* very tall shrubland.

Phenology. Flowering specimens have been collected from September to November and in April.

Conservation status. Recently listed as Priority One under DEC Conservation Codes for Western Australian Flora. This species is a narrow-range endemic that is not currently protected within the State's conservation estate.

Etymology. The epithet is derived from the Greek *atrichos* (without hair) and refers to the distinctive, glabrous sepals of this species.

Affinities. Hibbertia atrichosepala may be confused with *H. mucronata*, *H. hamulosa* and *H. abyssa* which are all known from the Ravensthorpe region. It differs most obviously from these taxa in having glabrous sepals. *Hibbertia mucronata* differs further from *H. atrichosepala* in having shorter peduncles (to 2 mm long) with simple hairs, and young stems with densely pilose rather than stellate hairs. Unlike *H. atrichosepala*, *H. hamulosa* has densely stellate-hairy rather than glabrous stem ribs, shorter (2–4 mm long) and densely stellate-hairy peduncles, and mature leaves which tend not to spread beyond 45 degrees to the stem. A comparison with *H. abyssa* is provided in the affinities under that species. *Hibbertia carinata*, a poorly known species recorded between Hatters Hill and Esperance, has more or less glabrous sepals but can be readily differentiated from *H. atrichosepala* by its sessile flowers with 9–12 stamens.

Acknowledgements

We thank Rosemarie Jasper and the Ravensthorpe Range survey team for bringing these two new species to our attention; Adrienne Markey for her persistent efforts in obtaining material and photographs of *H. abyssa* and for her assistance in preparing the Declared Rare Flora nomination for this species; Ryonen Butcher for her observations, type gathering and photographs of *H. atrichosepala*; Jess Allen and Damien Rathbone for field survey; Geoff Cockerton for providing additional survey data; and Judy Wheeler for her previous taxonomic work on *H. mucronata* and allies, which made taxonomic assessment of these two new species a relatively straightforward endeavour. This paper was supported by the Department of Environment and Conservation's *Saving our Species* biodiversity conservation initiative.

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SHORT COMMUNICATIONS

Ptilotus luteolus, a new combination in *Ptilotus* (Amaranthaceae)

Benl has been the most prominent recent author on the genus *Ptilotus* R.Br., and described a number of infraspecific taxa from a small amount of material. Many new collections have now been made and it has become apparent that the ranking of these taxa is in need of review. After infraspecific taxa in *Ptilotus astrolasius* F.Muell. were examined it became apparent that *Ptilotus astrolasius* var. *luteolus* Benl & H.Eichler warrants the rank of species.

Ptilotus luteolus (Benl & H. Eichler) R.W.Davis, *stat. et comb. nov.*

Ptilotus astrolasius var. *luteolus* Benl & H. Eichler, *Nuytsia* 4: 269 (1983). *Type*: 8 miles [13 km] south of Meekatharra on Gabanintha road, Eremean Province, Western Australia, 22 September 1957, *N.H. Speck* 884 (*holo*: CANB; *iso*: PERTH).

Ptilotus luteolus clearly differs from *Ptilotus astrolasius* in having a denser leaf indumentum with verticillate hairs that are much longer and distinctly branched, compared with a sparser leaf indumentum on *Ptilotus astrolasius* with hairs that are largely stellate and only shortly branched. Spikes in *P. luteolus* are yellow, but they are mostly green with a pink tinge in *P. astrolasius*. The bracteoles, tepals, and style in *P. luteolus* are consistently much longer than in *P. astrolasius* (Table 1), while the seeds are black in *P. luteolus* they are brown in *P. astrolasius*.

There are differences in habitat, with *P. luteolus* preferring rocky slopes, screes, and ridges while *P. astrolasius* occurs on in varied habitats including hills, plains and the bases of sandy dunes. The distributions of the two taxa are allopatric, with *P. luteolus* occurring in the southern Gascoyne and Murchison IBRA regions and *P. astrolasius* in the northern Gascoyne, Pilbara and through to the Kimberleys.

Table 1. Morphological comparison of *Ptilotus austrolasius* and *P. luteolus*

Characters	*Ptilotus astrolasius*	*Ptilotus luteolus*
Spike colour	green, pink	yellow
Spike width (mm)	7–13	14–18
Bracteole length (mm)	2.5–3.6	3.8–4.1
Outer tepal length (mm)	4.4–5.3	6.2–7.6
Staminal cup length (mm)	0.5–0.8	1.2–1.4
Style length (mm)	1.7–2	2.8–3
Seed colour	brown	black

Benl (1983), after listing the many differences between the two taxa cited a small number of specimens of the typical variety that he felt tended towards var. *luteolus*. However, assessment of the many extra collections now in PERTH, as well as field observations, show that the taxa are distinct and with no intergradation or intermediates.

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R.W. Davis

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983

An interim key to the Western Australian tribes and genera of Myrtaceae

In his treatment of Australian Myrtaceae for *Flora Australiensis*, Bentham (1867) provided a key to 41 genera, classified in three tribes. More than a century passed before another key to the Australian genera appeared (Johnson & Briggs 1983), this time with 75 genera and 11 informal groups that were intended to be equivalent to tribes. In 2005 a new formal classification for the Myrtaceae (Wilson *et al.* 2005) increased the number of tribes recognised in Australia to 15[1], but this paper did not include any keys. Approximately 85 Australian genera are now recognised, including 30 endemic to Western Australia. Ten tribes are represented in Western Australia and, since mid 2009, 54 genera have been listed for the State on *FloraBase* (Western Australian Herbarium 1998–).

In Western Australia most of the myrtaceous genera occur in the southern region covered by Blackall & Grieve (1980) and the rest occur in the northern region known as the Kimberley, for which there is a more recent key (Rye 1992). Blackall & Grieve's key contained 29 genera, far less than are now recognised and often very differently circumscribed, and it had the disadvantage that some genera were keyed out jointly, for example *Astartea* DC. with *Baeckea* L. and *Scholtzia* Schauer. Changes to the 12 genera included in the Kimberley key have been much less significant, although species belonging to two additional genera (*Asteromyrtus* Schauer and *Backhousia* Hook. & Harvey) have recently been discovered in the Kimberley. Clearly both regional keys are now inadequate and, in any case, it would be more useful to have a key for the whole State.

Taxonomic research is likely to continue altering the number of genera recognised within the Myrtaceae for many years to come, particularly in the large tribe Chamelaucieae which contains over half of the Western Australian genera. A prime example of the problems within this tribe is the polyphyletic genus *Baeckea s.lat.* With the recognition in the 1980s that *Baeckea s.lat.* comprised a number of distinct genera, including some that had been subsumed by Bentham (1867) in his broad concept of the genus, a process of reinstating old genera and naming new segregate genera was commenced by Trudgen (1986, 1987) and has continued up to the latest papers by Wilson *et al.* (2007), Rye & Trudgen (2008) and Rye (2009a,b). During this process 22 eastern Australian species and 20 Western Australian species have been formally reassigned, while many others have been newly named in their correct genera. *Baeckea s.str.* is now considered to comprise 13 species extending from southern China south to Tasmania, with most species occurring on the east coast of mainland Australia and with no representatives in Western Australia.

Despite this new understanding of the correct generic limits of *Baeckea*, it is still far from clear how many genera should be recognised in Western Australia for the very numerous species that await reassignment. In a few cases the only published names available for Western Australian species are in genera that have not yet been reinstated in a research paper. Hence, specimens of *Anticoryne diosmoides* Turcz. and *Tetrapora glomerata* Turcz. are now included under those names on FloraBase although their congeneric relatives are still retained in *Baeckea s.lat.* Fortunately all this taxonomic work has largely solved the problems in eastern Australia, where there are far fewer species belonging to the tribe and no longer any anomalous species included in *Baeckea*.

[1] including one found on Lord Howe Island but not on the mainland

As an interim measure to permit identification of Western Australian genera, a *status quo* key is presented here. At the same time the opportunity is taken to key out the ten tribes represented in Western Australia. In the first half of the key, the genera belonging to all tribes except the Chamelaucieae are accounted for. The remainder of the key is taken up with the many genera of tribe Chamelaucieae. Since the generic concepts in this tribe are under review, alternative generic names are given in brackets below some of the generic names currently in use. It is likely that the names in brackets will eventually become accepted for all or some of the species that key to those positions. *Baeckea s.lat.*, which keys out multiple times and is given in inverted commas, will eventually be eliminated entirely.

This interim key should allow users to begin recognizing the new genera and help them gain an understanding of which genera are related by indicating their placement in the tribal classification. It is intended to update the information presented in the existing electronic key to Western Australian genera of all families (Macfarlane *et al.* 2006–) in the near future to make it effective as an alternative means to identify the Myrtaceous genera.

Notes on the Western Australian tribes

As the primary aim of this key is to provide simple characters to distinguish genera, the main morphological reasons for the recognition of the various tribes are not always apparent. Seven of the tribes each contain only one or two Western Australian genera, making them easy to key. The tribes Melaleuceae and Leptospermeae each contain nine genera and both tribes key out at two or three positions. For the most part they can be distinguished by the presence or absence of stamen fascicles respectively, but one genus of each tribe is atypical in this respect. Another largely complete difference is in the length of the stamens, which always exceed the petals in the Melaleuceae but are shorter than to slightly longer than the petals in all genera of the Leptospermeae except *Asteromyrtus* and *Kunzea* Reichb. A more significant difference between the genera now placed in those two tribes appears to be in their bark anatomy, as first discovered by Bamber (1962). The bark anatomy of the Leptospermeae matches that of the Chamelaucieae and molecular studies (e.g. Wilson *et al.* 2005) have concurred in showing a close relationship between these two tribes.

Anther types in the Myrtaceae

Characteristics of the anthers are crucial in understanding generic boundaries in the Myrtaceae. The primitive anther type (Figure1A), found in some members of all tribes, is dorsifixed and versatile (with the filament narrowly attached on the back of the anther body and an easily moveable anther), and has parallel cells (also known as thecae) that open longitudinally. One of the defining characteristics of the Myrtaceae is the presence of a connective gland, protruding from the connective tissue above the point of attachment of the filament. This connective gland is most obvious in young anthers prior to dehiscence.

Various modifications of the anthers characterise particular genera. These include changes to the way the anther is attached (e.g. to being basifixed or having a broad adnate attachment), changes in the alignment of the anther cells so that they diverge at the base or apex (or they may curve outwards at the middle and meet at both the base and apex), changes to the kind of dehiscence (e.g. to transverse slits or pores), changes in the shape and position of the connective gland, and the fusion or loss of various components of the anther. The anther morphology is sometimes so greatly modified that interpreting its structure can be very difficult.

For the connective gland the most important character used in the key is whether the gland is free or fused. It is regarded as being free if it forms a separate lobe, which varies from much smaller than (Figure 1A) to larger than (Figure 1B) each of the anther cells. It is called fused if its swollen body is adnate to other parts of the stamen or if it is incorporated within the anther rather than forming a distinct structure. This fused state was used by Niedenzu (1893) to separate *Baeckea* subg. *Hysterobaeckea* Nied. from taxa such as *Baeckea s.str.* that had the primitive anther type. Often the connective gland appears to be fused to the distal part of the filament so that the anther is attached not by a narrow filament but by a swelling, the base of which is attached at right angles to the normal filament below (Figure 1C). In *Tetrapora glomerata* the connective gland appears to be absent as it is fused with the cells into a more or less globular, dark-coloured anther (Figure 1D), although the almost black top of the anther is probably where the gland resides. Another example of an anther type in which the fused connective gland is not obvious is the helmet-shaped anther referred to in couplet 50 of the key (Figure 1E).

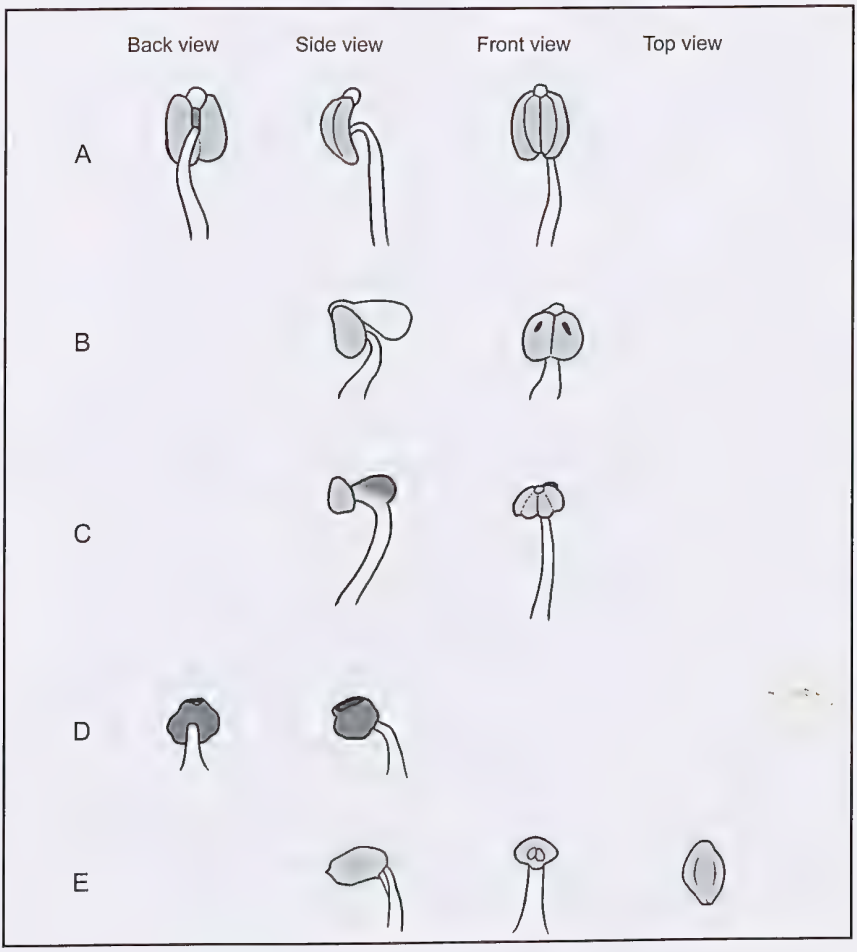

Figure 1. A – stamen of *Baeckea s.str.* with a versatile anther, longitudinal dehiscence and a free terminal connective gland; B – stamen of *Aluta* Rye & Trudgen, with a very large free connective gland directed towards the back of the dorsifixed filament, dehiscent by pores. C – stamen of *Orthomorphus* ms, with the large connective gland apparently fused to the distal end of the filament. D – stamen of *Tetrapora glomerata* Lindl. with an extremely modified dark anther, the more blackened distal part probably being the gland. E – stamen of *Babingtonia* Lindl., the anther resembling a bicycle helmet from top view, no gland visible.

Key to Western Australian tribes and genera of Myrtaceae

1. Tall shrubs or small trees of mangrove habitats. Petiole base expanded to enclose axillary bud. Sepals and petals identical and forming a single whorl of 8, free **(tribe Osbornieae)**..... **Osbornia**

1: Dwarf shrubs to tall trees, never occurring in mangrove communities. Petioles not expanded, sometimes absent. Sepals 4–6 or rarely absent and petals 4–6, sometimes one or both whorls united into a deciduous operculum

2. Fruit indehiscent, succulent or somewhat succulent (a berry or drupe). Occurring in the northern part of the Kimberley Region

3. Young stems glabrous. Inflorescence of terminal and/or axillary cymes or panicles of cymes. Sepals free or united into an operculum, glabrous. **(tribe Syzygieae)**..... **Syzygium**

3: Young stems hairy. Inflorescence of solitary axillary flowers or rarely axillary cymes. Sepals free, densely hairy outside or densely ciliate. **(tribe Myrteae)**

4. Sepals and petals 4, sparsely hairy or glabrous outside, densely ciliate. Stamens all or some longer than petals..... **Eugenia**

4: Sepals 5, densely hairy; petals 5, moderately hairy outside. Stamens shorter than petals..... **Lithomyrtus**

2: Fruit indehiscent or dehiscent, membranous to very woody (a nut or capsule). Widespread in Western Australia or restricted to the south

5. Sepals and/or petals united into an operculum, which is shed when the bud opens. **(tribe Eucalypteae)**

6. Cotyledons reniform. Hairs commonly present on juvenile plants and sometimes on young stems and leaves. Seeds very compressed and/or with a terminal wing..... **Corymbia**

6: Cotyledons 2-lobed. Hairs absent. Seeds terete or angled to somewhat compressed, sometimes winged along the angles..... **Eucalyptus**

5: Sepals and petals free or shortly united, one or both whorls usually persistent in flower

7. Ovary almost superior, developing into a capsule with longitudinal dehiscence. (Occurring in the Kimberley Region.) **(tribe Xanthostemoneae)**..... **Xanthostemon**

7: Ovary usually inferior or largely inferior, developing either into a capsule that is dehiscent by terminal valves or into an indehiscent fruit

8. Flowers pedicellate, in loose axillary cymes 20–100 mm long (including peduncle). Occurring in the Kimberley Region

9. Stems with a milky sap. Stamens united into 5 antipetalous fascicles. Fruit dehiscent by 3 valves. **(tribe Lophostemoneae)**..... **Lophostemon**

9: Stems without a milky sap. Stamens free. Fruit indehiscent. **(tribe Backhousieae)**.... **Backhousia**

8: Flowers sessile or stalked, solitary in the axils or in varied arrangements but not as above. Widespread in Western Australia or restricted to the south

10. Ovary (2)3–5-locular; ovules 1–230, when numerous arranged in multiple rows across the placenta. Fruit a valvate capsule, sessile. Seeds narrow in most genera, with a membranous or papery testa. Embryo with cotyledons equalling or longer than the hypocotyl

11. Stamens united into long antipetalous fascicles greatly exceeding the length of the petals, sometimes with the fascicles also united to one another

12. Placentas axile-basal, with a moderate number of ovules, not peltate. Seeds narrowly elliptic to obovate in outline, distally winged. Occurring in the Kimberley Region. (**tribe Leptospermeae** ***p.p.***) ..... **Asteromyrtus**

12: Placentas axile-medial, with 1–230 ovules, peltate when ovules numerous. Seeds of varied shape, often narrowly oblong to linear in outline, not winged or with lateral wings. Restricted to southern and central parts of Western Australia except for *Melaleuca*, which is widespread (**tribe Melaleuceae** ***p.p.***)

13. Anthers attached by the base, erect, the cells often divergent, opening in various ways (transversely, longitudinally or by pores)

14. Anther cells opening at the top by transverse slits. Ovules 1 per loculus ..... **Beaufortia**

14: Anther cells opening by terminal pores or opening outwards by transverse or longitudinal slits. Ovules 2 to numerous per loculus

15. Anther cells opening outwards by transverse slits ..... **Phymatocarpus**

15: Anther cells opening by longitudinal slits or by pores

16. Leaves usually not exceeding 15 mm long. Stamen fascicles 5, of varied colours

17. Leaves opposite and decussate. Flowers in dense heads. Ovules 4 per loculus ..... **Regelia**

17: Leaves alternate. Flowers solitary or in small clusters of 2 or 3. Ovules 7–23 per loculus ..... **Eremaea**

16: Leaves usually at least 20 mm long. Stamen fascicles 4 or sometimes 5, usually red ..... **Calothamnus**

13: Anthers dorsifixed, versatile, with parallel cells opening longitudinally

18. Stamen fascicles united into a tube for at least half their length ..... **Lamarchea**

18: Stamen fascicles separate or shortly united at the base

19. Leaves opposite. Ovules 1 per loculus ..... **Conothamnus**

19: Leaves alternate or rarely opposite. Ovules 2–230 per loculus ..... **Melaleuca**

11: Stamens free, shorter than to slightly exceeding petals in most genera but distinctly longer in *Callistemon* and *Kunzea*.

20. Stamens distinctly longer than the petals

21. Leaves 30 mm or more long. Flowers red, 20–30 mm long, in a subterminal cylindrical spike up to 120 mm long. (**tribe Melaleuceae** ***p.p.***) ..... **Callistemon**

21: Leaves up to 15 mm long. Flowers usually pink, white or yellow and 4–20 mm long but red and *c.* 30 mm long in one species, in a head or rarely a short spike, usually terminal. (**tribe Leptospermeae** ***p.p.***) ..... **Kunzea**

20: Stamens shorter than to just exceeding the petals. (**tribe Leptospermeae** ***p.p.***)

22. Leaves opposite. Fruit thin-walled ..... **Angasomyrtus**

22: Leaves alternate. Fruit woody

23. Flowers in dense, globular, axillary or terminal heads. Petals tending to persist after flowering. Ovules and seeds erect or ascending

24. Stamens 10, with 1 opposite each sepal and petal. Ovules 2(3) per loculus..... **Taxandria**

24: Stamens more than 10, with 3–7 opposite each sepal and 1 or none opposite each petal, i.e. mostly antisepalous. Ovules 3–14 per loculus

25. Leaves not clustered. All stamens antisepalous, none opposite the petals ..... **Agonis**

25: Leaves densely clustered. Antipetalous stamens present as well as antisepalous ones ..... **Paragonis**

23: Flowers solitary, loosely arranged or clustered but not in globular heads. Petals deciduous. Ovules and seeds horizontal or pendulous

26. Leaves grading into bracts. Seeds 1 per loculus, developed from the basal ovule (i.e. the upper 'ovules' functionally ovulodes)..... **Pericalymma**

26: Leaves quite distinct from the bracts. Seeds not restricted to 1 per loculus (i.e. more than 1 true ovule present in each loculus)

27. Anthers not ridged. Ovary summit glabrous or hairs not forming radiating bands. Seeds varied but not as below ..... **Leptospermum**

27: Anthers with 2 abaxial ridges on each side of connective. Ovary summit with radiating bands of hairs delimiting the loculi. Seeds disc-shaped, winged..... **Homalospermum**

10: Ovary 1–3(–5)-locular; ovules 1–12(–25) per loculus, when numerous arranged either in 2 parallel rows or in a circle (i.e. radiating from the centre of the placenta). Fruit either indehiscent or containing seeds with a hard testa. Embryo with cotyledons much smaller than the large hypocotyl. **(tribe Chamelaucieae)**

28. Flowers in a daisy-like inflorescence with the outer flowers sterile, 4-merous, with 4 petaline sepals, 4 petals and 8 stamens ..... **Actinodium**

28: Flowers variously arranged, all fertile, 4–6-merous and usually with sepals and petals dissimilar, if 4-merous then sepals absent, never with a constant stamen number of 8

29. Androecium with 20 filaments (stamens or staminodes) united at base into a ring, the antipetalous ones always stamens and those alternating with the petals and sepals usually staminodes; staminodes (present in all genera except *Pileanthus*) varying from tooth-like or filiform to expanded and resembling a small petal. Fruit 1-locular, indehiscent

30. Sepals deeply 2-lobed. Stamens 20. Staminodes absent ..... **Pileanthus**

30: Sepals entire to greatly divided, sometimes also with accessory lobes. Stamens 10 or rarely 5. Staminodes 10 or rarely 15

31. Sepals deeply divided; petals deeply divided to entire..... **Verticordia** ***s.lat.*** (including **Chrysorhoe**)

31: Sepals and petals never deeply divided, margin entire, denticulate or ciliate

32. Anthers dehiscent by 2 longitudinal slits. Ovules 4–10..... **Chamelaucium**

32: Anthers dehiscent by 2 terminal pores. Ovules 2..... **Darwinia** ***s.lat.*** (including **Genetyllis**)

29: Androecium of 3–150 free or united filaments, not consistently with 20 filaments; staminodes absent or not constant in number, not arranged as described above, never petal-like but sometimes retaining the connective gland. Fruit 1–5-locular, indehiscent or dehiscent

33. Leaves alternate (except in a few species of *Calytrix*). Petals and stamens erect in bud (except in most species of *Homalocalyx*). Hypanthium often very slender. Stamens 10–150; anther dorsifixed and usually versatile. Ovary 1-locular, with 2 ovules (except 1 species with 3 or 4 ovules)

34. Stamens all or mostly erect in bud. Sepals long-awned in most species. Embryo straight, the cotyledons erect ..... **Calytrix**

34: Stamens all inflexed in bud except in *H. ericaeus*. Sepals not awned. Embryo curved, with cotyledons on a slender neck appressed to a massive hypocotyl ..... **Homalocalyx**

33: Leaves opposite or whorled. Petals and stamens inflexed in bud or rarely petals sub-erect. Hypanthium moderately slender to very broad. Stamens 3–60 or if more numerous then anther ± basifixed. Ovary 1–5-locular, with 1–25 ovules per loculus

35. Connective gland free from the filament and anther cells, usually obvious and dorsal or terminal but if gland not obvious then cells free and long

36. Anthers basifixed or with filament attached almost at base of connective. Seeds often with a prominent adnate protrusion along the inner surface

37. Anther cells close at apex but very divergent at base, the connective triangular, with a wide basal attachment. Seeds strongly facetted, with no inner protrusion..... **Seorsus**

37: Anther cells ± parallel, the connective not much broader at base than at top. Seeds not facetted or with facets poorly developed, often with an obvious inner protrusion

38. Stamens 8–30, united into an undulating or fairly level petaline ring (the leaves always opposite-decussate). Seed body and enclosed embryo broadest towards distal end of the fruit loculus ..... **Cyathostemon**

38: Stamens 3–125 in varied arrangements (if androecium as above then leaves in whorls of three). Seed body and enclosed embryo broadest towards base or outer margin of the fruit loculus

39. Leaves tending to be fasciculate, always narrow. Stamens 3–60, when very few then all or mostly widely spaced, when more numerous then all or mostly in antisepalous fascicles. Seeds 0.5–1.3 mm long, thin-walled or moderately thick-walled..... **Astartea**

39: Leaves never fasciculate, sometimes broad. Stamens 10–125, basally united into a continuous circle or, when few, sometimes with gaps present. Seeds 0.8–2.3 mm long, thick-walled..... **Hypocalymma**

36: Anthers dorsifixed near centre of dorsal surface, but in one genus (*Rinzia*) adnate to the inner surface of a flattened filament. Seeds either with a free aril on inner surface or with no obvious inner protrusion

40. Style base inserted in a depression. Fruit 2–5-locular, dehiscent or if indehiscent (*Enekbatus*) then with a very thick hard wall. Seeds ± reniform (rarely obovoid), sometimes with a whitish free aril; testa thick, hard, usually colliculate or tuberculate

41. Androecium of 5–12 stamens; antipetalous filaments 0.5–1 mm wide, emarginate, truncate or obtuse; antisepalous filaments (when present) united shortly at base or for half to nearly their full length to the antipetalous filaments; anthers attached to inner surface of filament ..... **Rinzia**

41: Androecium of 3–30 stamens; filaments very slender or rarely up to 0.6 mm wide, attenuate at apex, free; anthers with a narrow dorsal attachment at slender summit of filament

42. Ovary 2–5-locular, sometimes with one loculus sunken below the others or with 2 superposed ovules in each loculus. Fruit fully indehiscent or with 2 upper loculi dehiscent and a somewhat lower loculus indehiscent

43. Flowers ± sessile. Hypanthium circular in transverse section. Ovary loculi usually all with 2 ovules. Fruit with all of the 2–5 loculi at the same level, fully indehiscent ..... **Enekbatus ms**

43: Flowers stalked. Hypanthium 5-angled. Ovary loculi with 1–7 ovules, upper loculi usually with more than 2 ovules. Fruit with loculi at two overlapping levels, lower level with an indehiscent loculus and upper level with 2 dehiscent loculi ..... **Astus**

42: Ovary 3-locular in all or most flowers, with ovules collateral or in 2 rows. Fruit with all loculi dehiscent

44. Leaves with parallel venation usually visible on upper surface. Peduncles 0.5–9 mm long, 1–4-flowered. Antipetalous processes forming prominent groups. Seeds usually with an obvious free whitish aril surrounding a small hilum ..... **Euryomyrtus**

44: Leaf venation obscure or not as above. Peduncles ± absent or up to 0.6 mm long, 1-flowered. Antipetalous processes free and inconspicuous or absent. Seeds without an aril but sometimes with a large concave or flat hilum

45. Filaments of antipetalous stamens flat, 0.25–0.6 mm wide throughout. Seeds without any obvious cavity or large hilum; testa minutely colliculate..... **Rinzia (=Latistemon ms)**

45: Filaments narrow for all or most of their length, less than 0.25 mm wide in distal half. Seeds either with a large concave or flat hilum on inner surface or with the testa tuberculate

46. Androecium with 5–20 stamens but no regularly occurring staminodes, with varied arrangements of the stamens but rarely exactly as in the next choice. Ovules 2 per loculus. Seeds 1.1–1.5 mm long, with a large concave and longitudinally divided hilum;testa colliculate ..... **'Baeckea' (=Semasperma ms)**

46: Androecium with a circle of 16–36 members consisting of 3 or 4 long stamens opposite each petal (i.e. antipetalous) and with shorter antisepalous stamens or staminodes. Ovules 3–5 in all or some loculi. Seeds 1.6–2.2 mm long, with hilum either small or flat, not divided; testa tuberculate..... **'Baeckea' (=Aethestemon ms & Xeromesos ms)**

40: Style base not in a depression. Fruit 1(2)-locular, indehiscent, thin- or moderately thick-walled. Seeds of very varied shapes including reniform, never arillate; testa very thin, membranous, smooth

47. Stamens 5–10, with one stamen opposite each petal (i.e. antipetalous) and sometimes also opposite all or some of the sepals; antisepalous stamens (when present) shorter and often lower than antipetalous stamens; anther cells ± parallel or divergent at summit. Ovules somewhat pendulous from a placenta that is located towards summit of ovary

48. Peduncle fused at summit to the bracteoles and flower. Sepals dimorphic, the 2 abaxial sepals broad and the 3 adaxial sepals narrower. Anthers terminated by a long-stalked connective gland..... **Corynanthera**

48: Peduncle free. Sepals ± equal. Anthers with a short unstalked connective gland..... **Micromyrtus**

47: Stamens 5–40, if few then all antisepalous, if 10 then often alternating with the sepals and petals, in the few species with 10 opposite sepals and petals the anther cells divergent at the base. Ovules erect, attached laterally or towards the base of ovary

49. Hypanthium reticulate-pitted or closely wrinkled. Connective gland (of the anther) with a long obovoid body directed towards outside of flower. Disc markedly reticulate-pitted. Ovules 4–6..... **Aluta**

49: Hypanthium with 5–16 irregular longitudinal ribs or smooth or rugose. Connective gland (of the anther) with a compact body, directly above top of cells and directed inwards. Disc smooth or with prominent oil glands. Ovules 2 in most species but up to 10..... **Thryptomene *s.lat.*** (including **Paryphantha**)

35: Connective gland adnate to the filament or cells or fully incorporated with fused cells into a very modified anther, the cells often short

50. Anthers helmet- or shield-like, often with a groove along each side or distally 2-lobed. Filaments compressed, numerous and continuous or less commonly few and antisepalous (i.e. with gaps opposite the petals)

51. Peduncles 1-flowered. Flowers with petals 4–7 mm long, sepals 1.1–1.6 mm long and 12–45 stamens. Restricted to Fitzgerald River National Park..... **Anticoryne**

51: Peduncles 1–20-flowered. Flowers with petals 1.3–6.5 mm long (if petals more than 5 mm long then sepals 0.2–1.1 mm long) and 3–25 stamens. Occurring from north of Geraldton to the Mount Barker area..... **'Baeckea'** (=**Babingtonia**)

50: Anthers of varied shape including globular to obloid but not as in the above choice. Filaments of varied shape and arrangement, sometimes matching above choice

52. Fruit indehiscent, 1–3-locular, usually with a maximum of 1 seed per loculus

53. Ovules 1 or 2 per loculus..... **Scholtzia**

53: Ovules 3–20 per loculus

54. Ovary 1-locular; ovules 3–8..... **Malleostemon *s.lat.***

54: Ovary 2- or 3-locular; ovules 4–20 per loculus

55. Petals white. Stamens 16–29. Ovules 4–14 per loculus. Fruit not very woody..... **'Baeckea'**[2]

55: Petals bright pink or orange to red. Stamens 30–60. Ovules 10–20 per loculus. Fruit very woody..... **Cheyniana**

[2] *B. pentagonantha* F.Muell. group and *B.* sp. Melita Station (H. Pringle 2738)

52: Fruit dehiscent by 2 or 3 terminal valves, usually with multiple seeds per loculus

56. Hypanthium petaloid, orange to red, 9–20 mm long, with sepals and petals the same colour. Style 20–24 mm long at maturity..... **Balaustion**

56: Hypanthium herbaceous, green to reddish, 0.5–4 mm long, with sepals and/or petals contrasting in colour. Style 0.7–12 mm long at maturity

57. Fruit fully inferior, with the style inserted within a broad funnelled depression (which is also visible on the ovary of dried flowers)..... **Oxymyrrhine *s.str.***

57: Fruit usually partially superior, with apex level or raised, the style terminal or inserted within a narrowly cylindrical depression

58: Anthers globular, 0.2–0.3 mm long, black..... **Tetrapora**

58: Anthers of varied shapes, if globular then not as above ..... **'Baeckea'** (many groups including **Tilophloia ms** & **Orthomorphus ms**)

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Barbara L. Rye

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983

Referees for Volume 19(2)

The assistance of referees in providing expert review of papers submitted to *Nuytsia* is gratefully acknowledged. The referees consulted for Volume 19(2) include those listed below. Each paper was also refereed internally by *Nuytsia* Editorial Committee members.

Matthew Barrett
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Lindy Cayzer
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Nicholas Lander
Terry Macfarlane
Bob Makinson
Judy Wheeler
Paul Wilson

Corrections

Volume 19(1)

Page 1. Under heading **Introduction**, line 9: 'restricted to treeless sand flats over sandstone' should read 'restricted to treeless flats of skeletal sand over sandstone'.

Page 5. Under heading *Habitat,* line 5: *Hibiscus superba* should read *Hibiscus superbus*.

CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

R: Declared Rare Flora – Extant Taxa (= Threatened Flora= Endangered+ Vulnerable) Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

X: Declared Rare Flora – Presumed Extinct Taxa Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searhcing, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for Environment, after recommendation by the State's threatened Species Scientific Committee.

1: Priority One – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral aniamls, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

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4: Priority Four – Rare Taxa Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.

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Title. Should be concise and include the family name of genera or species treated (but not authorities) and geographic scope where appropriate. New taxa should be named if not numerous. Full author's names should follow the title, followed by institutional addresses keyed by superscripted letters. An email address should be given for the Corresponding Author, if possible.

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Keys. May be either indented (e.g. *Nuytsia* 18: 45) or bracketed (e.g. *Nuytsia* 18: 149). Indented keys involving more than nine levels of indentation should be avoided.

Conservation status. Conservation Codes as used by the Department of Environment and Conservation should be recommended for rare and threatened taxa; these will be assessed by Department staff during review of the paper. Precise localities and georeferences should not be given for Declared Rare and Priority taxa; instead, cite generalized localities only, accompanied by the statement "[Precise localities withheld for conservation reasons]".

Abbreviations. The following standards are used for abbreviations:

- Nomenclatural authors: *Authors of Plant Names* (Brummitt & Powell 1992).
- Bibliographic references (nomenclatural sections only): *Taxonomic Literature II* (Stafleu & Cowan 1976–1986; Stafleu & Mennega 1992–) for books; *Botanico-Periodicum-Huntianum* (Lawrence *et al.* 1968) for journals.
- Herbaria: *Index Herbariorum* (Holmgren *et al.* 1990).

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- *Journal article*: Butcher, R. (2007). New 'leafless' *Tetratheca* (Elaeocarpaceae, formerly Tremandraceae) taxa from Western Australia. *Australian Systematic Botany* 20(2): 139–160.
- *Book*: Paczkowska, G. & Chapman, A.R. (2000). *The Western Australian flora: a descriptive catalogue.* (Wildflower Society of Western Australia: Nedlands, WA.)
- *Chapter in a book*: Rye, B.L. (1992). Myrtaceae. *In*: Wheeler, J.R. (ed.) *Flora of the Kimberley Region*. pp. 499–546. (Western Australian Herbarium: Perth.)
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CONTENTS

Main papers

Short Communications

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